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CONTENTS.

	PAGE.
Costings	245
Cacao and Coffee	246
St. Lucia's Banana Industry (to be continued)	247
Mr. Ormsby-Gore's Tour (Concluded)	250
The Imperial College	254
Tropical Agricultural Research	255
Tropical World Notes	258
Cattle in India	260
Kunai	262
Entomological Notes	262
Mycological Notes	264
St. Vincent Arrowroot	265
Crop Products Manufacture	265
Reviews	266
Books Received	267
Chemical Notes	268
Sugar Notes	269
Cotton Notes	270
College News	270
Colonial Appointments	271
Mr. G. C. Skinner	271
Photographs	271
Professor C. Y. Shephard	271
Trend of the Markets	272
Trinidad Sugar, 1928	272

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COSTINGS.

It is only recently that the practice of keeping systematic cost accounts has been adopted on agricultural enterprises in the tropics while the analysis of such records is a comparatively modern line of research, the possibilities of which have yet hardly been explored. Ordinary financial records may have been kept by the early planters but no intricate accounting system was really necessary where production was effected by manual labour, under a more or less primitive factory system and where the owner of a small plantation could often base his judgment on his personal knowledge and experience. With the increase in the size of estates and of sugar factories, however, new methods of control were needed and some of them have taken the form of elaborate systems of cost accounting, an example of which is given in the supplement published with this issue. The value of these records has now been generally recognised and most sugar and other estates have adopted some forms of controlling their expenditure, which would compare very favourably with any adopted elsewhere, while it would be true to say that the practice of keeping accounts on agricultural holdings is probably more general in the tropics than in the temperate zones.

It has been said that "it is only by means of systematic records of this kind that leakage, waste and fraud can be prevented and that employers can find out actual costs of production and be able to determine accurately and scientifically, not merely approximately and by haphazard, the actual profit they make or loss they sustain, not only on the aggregate transactions during a given period but also upon each department of their business. Thus processes which are relatively unremunerative can be eliminated while more attention can be paid to those which yield more than the average profit."

The value of cost records, however, can be overestimated and no system should be adopted where, owing to a too detailed analysis of data, the main defects of an organisation cannot be detected. It is a common fault to find in cost systems that the number of forms on which the returns are tabulated is too large to meet the needs of the case and the first duty of a manager is to cut these down to a minimum. Superfluous records are a waste of time, money and energy while they are, in addition, possible sources of inaccuracy. Further, it should be also remembered that a system of cost accounts,

however carefully planned, can never be complete as it often rests on data which itself may be based on estimates. This is particularly the case in the production of crops and stock where difficulties are generally experienced in exactly entering the initial information. It is, for instance, not always possible to enter the exact number of hours that a man has worked in the field or, in the case of livestock, to weigh all the quantities of home grown foods fed. One can therefore seldom arrive at the real costs of production on an estate, but the figures eventually obtained from the records kept are near enough for the purpose for which they are intended.

The collection and tabulation of the data are in themselves comparatively simple processes and offer less difficulties than the actual analysis and interpretation of results which, if properly executed, should lead to some practical application of the knowledge gained. Where agriculture is concerned, the problem of interpretation is rendered very much more difficult by the fact that there are so many factors at work which are outside the manager's control: climate, soil, diseases, market fluctuations and the law of diminishing returns are all potential factors which may influence cost variations and their effects cannot be measured with any degree of accuracy. This is of course where a manager's skill comes into play and where his discretion must be used in comparing the concrete evidence at his disposal together with that over which he has no control. His conclusions, to be of any value, should therefore take into consideration all the information which he can get and should preferably be based on data that has been analysed for a period of years. Records, interpreted in this manner should be invaluable guides in the control of the technical staff and equipment which a manager has at his command, while they are the sole means of controlling work that he cannot surpervise himself, as for instance, in the case where he is in charge of several estates.

There are no doubt many examples that could be cited of the changes in actual practices that have been made on estates from the information gained through keeping a proper system of cost accounts, but there are many problems that still await solution. Differences of opinion exist, for instance, as to whether it is more economical in the running of a sugar factory to purchase canes from large estates or from small holdings or whether it is more profitable to finance the large instead of the small grower. Or again, the question of the organisation of an even supply of cane during the crop season is often a source of difficulty which might be solved with the help of labour and rolling stock records. Labour records would be the first to reveal the efficiency of a labour force on an estate and might possibly indicate ways and means by which its efficiency could be increased. Readjustments in the distribution of the labour at hand or changes in crop practices, may for example be dictated by a careful scrutiny of records. Comparisons could and should be made between the relative value and efficiency of tractor and animal power or of two similar types of implements or of two similar animals belonging to different breeds (*e.g.*: Buffalo and Zebu). With regard to stores and supplies it should always be possible with the help of records to detect leakages and waste and also to detect the relative value of the stores themselves (*e.g.*: uses of different grades of lubricating oil in a factory). These examples should be sufficient to illustrate the uses that could be made of a systematic collection of records. Each estate has its own problems to solve and has probably devised its own methods of control, but it would be particularly interesting to know to what extent systems varied and whether any simpler methods than the ones generally advocated, have been evolved. There is yet a considerable lack of knowledge available on cost accounts as it affects agriculture in the tropics, but it is hoped that the details of the organisation of a sugar factory which are published with this issue may bring forth some views on the subject.

It may be added that the data made available by cost accounts is invaluable to the study of agricultural economics. Official statistics can help an agricultural economist to a certain extent but he is in a much greater need of the information which can only be supplied by systematic recording and particularly of information which is afforded by scientific book keeping. Much statistical information of this kind is now being collected by various agricultural institutions in England with departments created specially for the purpose of studying the many problems which affect the economy of a holding and, with the help of economic surveys, of agriculture in general. Work on the same lines has also begun in the tropics, but is only in its earliest stages of development; it is to be expected, however, that when its importance has been realised that much more attention will be paid to it than heretofore.

CACAO AND COFFEE.

Production in French Colonies.

L' Agronomie Coloniale (No. 124) puts the total 1927 production of cacao in all the French Colonies at 25,000 tonnes as against a four-year average cacao consumption in France of 31,172 tonnes. With a slight increase in production French demands would therefore appear to be easily satisfied. The same, however, cannot be said of coffee, where the 1927 production in all the colonies only amounted to 5,000 tonnes as against an average consumption at home of 166,000 tonnes for the years 1921-25. In this direction therefore French colonial production might advantageously be increased.

ST. LUCIA'S BANANA INDUSTRY.

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THE purpose of the present paper is to provide a connected account of the inception and development of commercial banana planting in St. Lucia, with comments on the methods employed (1).

It is hoped in a future paper to give a description of the reactions of the soil and flora observed to take place in changing from a natural forest vegetation to a cultivated pure crop such as bananas, and the observations to be set forth therein will be found to have an important bearing on tropical agriculture in general. The present paper acts as an introduction to these observations.

The Gros Michel banana trade would be an attractive proposition were it not for the heavy losses suffered in conducting plantation work, when complicated by the presence of Panama disease. The following information, based on the writer's actual participation in all phases of the industry, includes an account of the work done locally on Panama disease and should assist in establishing the economic value of certain practices in connection with the attempted control of this disease.

Origin of Banana Industry.

St. Lucia, like other islands with a similar climate, had for some years previous to 1922, conducted a variable export trade in several varieties of bananas, chiefly the Short Fig or Governor banana, *Musa Cavendishii*. Paxt., the Bout Rond or Giant Fig and the Gros Michel or Martinique Fig. The principal market was Barbados, whence the fruit was shipped by sailing sloop.

Towards the end of 1922, a proposal for the development of large scale banana cultivation was received from the representative of certain fruit interests in the United Kingdom. This proposal was favourably received by the local Government and special facilities were granted, and an area of 200 acres of Crown land in forest was purchased by private interest vested in the Swift Banana Company, and the necessary steps were taken to enrol labourers for clearing and preparing the land.

The area acquired was situated about nine miles along the Castries-Dennery Main road and at an altitude of about 400 feet at a point where the forest reaches down to the road, the site was thus readily accessible.

The rainfall of this area averages about 100 inches yearly, and the soil when cleared from forest, is seen to be covered by a layer of decayed forest humus which readily desiccates on exposure. The soil itself is a yellowish-brown clay loam tapering off into hummocks of a red lateritic clay, and responds to careful cultivation. The contour of the land is of a rugged nature, consisting of steep ridges and folds enclosing narrow valleys with a few moderately smooth slopes.

The commencement of planting.

Preparations for planting commenced early in 1923 and consisted of felling the forest trees, some of which furnished useful building timber and roof shingles; but the greater proportion of the fallen logs were left where they fell or merely moved aside to allow of planting. The herbaceous undergrowth was burnt or cutlassed down, and lining and holing was commenced. At this stage the local Agricultural Department was called in to assist, and remained in co-operation with the Banana Company until the work was brought to an end by the dissolution of the Company.

The planting material was collected from both the large and small surrounding planters' holdings and consisted of sword suckers and bullheads of Gros Michel stools, being paid for at the rate of three cents per bullhead. About 90,000 plants were thus established in an area of 15 acres by the end of 1923, the actual planting having been commenced about April of that year.

One of the first steps taken by the local Department was to inaugurate a system of inspection of all planting material, at this time principally directed against the banana weevil *Cosmopolites sordidus*, Germ., and the banana borer *Tomarus bituberculatus*, Beaud., as these root pests were being found in a rather large proportion of the material supplied for planting.

The bullheads and suckers were treated by clearing away the loose trash and broken leaf bases, and by paring the roots, the plants being then soaked in lime-water for forty-eight hours to destroy any concealed larvae and eggs.

Plants were spaced at a distance of six feet each way to form a nursery to give bulk of planting material; when planted out in the fruiting areas the plants were spaced 12 feet by 12 feet.

The labour utilised throughout the work consisted of the local West Indian native, generally illiterate, and with crude ideas as to the value of disinfective and control methods, but a good mechanical worker. Both men and women were employed at the rate of 1*s.* 6*d.* and 10*d.* to 1*s.* per day respectively, at which rates ample labour was available.

Supervision was exercised by the more intelligent native overseers or "drivers," under the control of coloured assistants who were responsible to the European Manager.

Occurrence of Panama disease.

The first three cases of Panama disease were found in January, 1924, the plants infected being stools of about seven to eight months of age and situated on a slope in rather wet soil. The principal symptoms consisted of external yellowing of the lower leaves, and an internal yellowish-red discoloration of some of the vascular strands. In later cases where plants were more advanced in growth, splitting of the stem and some breaking of the petiole of the lowest leaf was observed, these latter symptoms,

however, were never really pronounced nor general and were usually found in conjunction with borer and weevil attacks, *i.e.* : severe dislocation of the food supply and ingress of bacteria to the vascular tissue. These symptoms differ somewhat from the published accounts, and will be discussed in the notes on soil conditions.

Measures taken against Panama disease.

The measures taken to control further spread of the disease come under four headings :—

(i) Treatment of infected areas,
(ii) Improved selection of planting material,
(iii) Survey of the distribution of Panama disease,
(iv) Propaganda.

(*i*) *Treatment of infected areas.*

In order to obtain the best advice possible, a visit of the Mycologist of the Imperial Department of Agriculture was arranged. Specimens of the diseased plants had already been submitted for examination and were reported on as showing characteristic symptoms of Panama disease. The visit of the Mycologist took place in August, 1924, and an inspection of the area was made. A report was then furnished giving the precautions necessary to reduce infection, viz. : (*a*) by firing the infected clumps and digging out and burning the diseased plants, and destroying the contacts within a radius of 22 yards, (*b*) by the disinfection of tools and the isolation of the infected areas.

The details of destruction of plants and disinfection were well adhered to and were generally carried out under the supervision of the Officers of the Agricultural Department.

The isolation of infected areas, however, was not complete owing to the difficult nature of the ground, and to the fact that the labourers did not regard the prohibited areas with the necessary respect.

(*ii*) *Improved selection of planting material.*

Selection of planting material was further improved by a method worked out by the writer, this consisted of the sectioning or quartering of the bullheads, which were then examined on both surfaces and also on the top where the central bud had been sheared away. The sections were then dusted with wood-ash and in some cases soaked in lime-water to destroy weevil and borer.

By this means it was found possible to reduce considerably the amount of infected planting material, and the method was adopted both in the plantations of the Swift Company and other banana cultivations which were springing up throughout the island, working in co-operation with the local Department.

The areas planted on this method were found to give an incidence of one diseased plant per 1,000 as against one per 100 in the unsectioned plants, the rate of spread was accordingly reduced and a longer life was possible for the fruiting plantations.

(*iii*) *Survey of Panama disease, and legislative action.*

A survey of the distribution of Panama disease throughout the Colony was made about this time, the results showing a scattered infection in practically all the estates on the leeward coast which are readily accessible and open to frequent traffic. On the windward coast little banana cultivation had been carried on in earlier times, and estates in this area showed but few Gros Michel and no cases of disease. One case of disease was found on an estate situated midway on a road running from coast to coast indicating that Panama disease was more widespread and of earlier origin than had at first been believed.

It thus became necessary to examine carefully every prospective banana cultivation, both with regard to the existing plants, and also to go into the history of the estates in order to determine whether Gros Michel had been planted in earlier times, and had disappeared owing to Panama disease. In this way much interesting information came to light, and the peasants were often of help in indicating that a 'malade' of the Gros Michel had become a part of their traditions. A striking case of the replacement of the susceptible Gros Michel by an immune variety occurred on an estate near Castries, from which a regular fruit trade with Barbados had been maintained; the total absence of the valuable Gros Michel was therefore remarkable and on research it became evident that this variety had died out from disease and had been replaced by the Bout Rond—a 'round end' banana of a somewhat soapy consistency and of a less delicate flavour. This variety was later identified as similar to the Giant Fig of Grenada.

Following the completion of the survey of disease, regulations were enacted to enforce destruction of bananas infected with Panama disease and the treatment of plants attacked by weevils and borers. The movement of planting material was also prohibited except by permit of the Agricultural Department, following an inspection of the estate in question.

The Department was allowed to train two men as travelling inspectors of banana cultivation, and these men rendered valuable assistance in recording outbreaks of disease, and by carrying out actual treatment of diseased plants. Altogether 28,831 diseased plants were treated during the period 1925 to 1928 mainly by the officers of the Agricultural Department. It may safely be said that the attitude of the peasantry has entirely changed owing to the educative effect of the inspection service, and the peasant now realises that disease is a condition brought about by some destructive organism and not the wilful act of a far-seeing Providence.

Information was obtained as to the total distribution of all banana crops and of projected crops. The diseases were noted, and the accessibility of land suited to bananas, was recorded for future reference. This information has proved valuable both in regard to banana cultivation and to other crops which are being substituted for bananas.

STUDENTS' READING ROOM.

Photograph by *Tucker Picture Co.*

CARD ROOM.

Photograph by *Tucker Picture Co.*

INTERIOR OF COLLEGE DINING HALL.

Photograph by *Tucker Picture Co.*

INTERIOR OF STUDENT'S ROOM.

Photograph by *Tucker Picture Co.*

(*iv*) *Propaganda.*

Planters and others were instructed in the symptoms of Panama disease, the treatment of diseased plants, and the methods of planting. Meetings were held at various centres where specimens of plants were exhibited, and a leaflet, *The control of Panama disease* was printed in simple language and distributed throughout the Colony. ([2]).

Frequency of Panama disease.

On checking up the information obtained on the survey a fairly definite idea was obtained of the frequency of cases of Panama disease. Infection in the S.W. area of the Colony was at the rate of 0.7 per cent. and for the N.E. area was 2.5 per cent. whereas the lands of the Banana Company gave a range of 0.5 per cent. to 20 per cent. infection in the older areas.

Soil Conditions and Panama disease.

Judging by the few published accounts dealing with soil conditions and Panama disease, there appears to have been little work done on the types and conditions of soil in which Panama disease flourishes, as compared with the types of soil where the fungus can he held in check, such as the irrigated lands of Jamaica and Columbia.

It is therefore of interest to record certain detailed observations with regard to the soil medium and the reaction of bananas to varying soil conditions. One of the most striking effects was noticeable in bananas planted towards the base of the slopes, these grew vigorously and produced good bunches, whereas plants on the tops of ridges shewed dwarfing effects, yellowing of leaves, and produced only poor fruit. These exposed plants gave a poor rotation of fruiting stems and suffered from drought brought about by the complementary factors of leaf splitting, an inferior type of soil and irregular water supply.

On the other hand, the modifying action of windbreaks with the improved soil conditions found nearby, was evidenced in the vigorous growth of the plant and the absence of leaf splitting, humus was conserved and little leaching appeared to take place.

The following observations deal with two distinct types of soil:—

(I) *Soil conditions in the Nursery—Ravine Poisson.*

The soil here at the time of planting, might be termed a virgin soil, undisturbed by earlier cultivation and bearing large forest trees forming the closed tropical rain forest vegetation with a well developed canopy.

On removal of the timber by felling, and within six or eight weeks a crop of soft weeds covered the ground forming a transition stage, preceding the establishment of the larger herbaceous plants.

The soil consisting of a brownish yellow clay loam covered by a loose layer of forest humus about three inches deep, this covering had become matted by surface roots and was not well decayed. The soil when cut in profile shewed as a smooth cheesy clay loam in which aeration appeared to be defective as depth increased, the upper six inches being somewhat improved in texture by decaying roots. The soil puddled readily when worked in wet weather but responded to aeration and applications of lime by changing in colour from brownish-yellow to brownish-grey, and by forming a definite crumb structure.

This type of soil under wet weather conditions became puddled and needed extensive drainage, in the lower areas the soil was never really dry and the bananas never suffered from drought.

During dry weather the soil cracked readily causing drought conditions, particularly along the ridges.

(II) *Soil conditions on the hill slopes and new areas, Mt. La Combe.*

Soil conditions in the new upper areas along the slopes of Mt. La Combe were notably different from conditions in the lower land and nursery.

The soil here had supported a similar forest vegetation to that already described, but when examined in profile showed a distinct stratification formed by a superficial layer of humus resting upon a bed of yellow clay, in which there appeared to be no admixture of the overlying organic matter. The soil was naturally stiff and difficult to work, readily becoming sticky in wet weather. Dry conditions were never observed owing to the continuous seepage of surface water from the upper slopes.

This is a type of soil which must be worked, it requires extensive drainage and applications of lime, otherwise it deteriorates.

[The Bibliography relating to the whole article has been published in this issue and will not be reprinted, but should be referred to when the remainder of the article is published.—ED.]

(*To be concluded.*)

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MR. ORMSBY-GORE'S TOUR.

Tropical Agriculture in Malaya, Ceylon and Java.

(*Concluded.*)

[*The following extracts are taken from a paper read by the Right Hon. W. Ormsby-Gore,* M.P., *Parliamentary Under Secretary of State for the Colonies, to the Royal Colonial Institute, on his recent tour to Malaya, Ceylon and Java.*—Ed.]

The headquarters of the Department of Agriculture in the Netherlands Indies are at Buitenzorg and the work is associated around the main economic experimental gardens, the Botanical Gardens, which are a tropical counterpart of Kew, the central forestry station and the veterinary research station all in that town. In all there are resident in the small town of Buitenzorg something over 100 European scientists attached to one or other of the various research stations and institutions, and this mere association on such a scale is an immense incentive to effort.

It is quite obvious that however great an assembly of brains and money are devoted to agricultural research there will not be a translation of their results into practice unless there is a plentiful supply of both Europeans and natives familiar with the work and capable of bringing the new knowledge not merely to the plantations but to the villages and the ordinary peasant. It is in this that the success of the Dutch is so outstanding.

At the centre there is the Agricultural College at Buitenzorg for persons of all races. This institution corresponds in some measure to the Imperial College of Tropical Agriculture in Trinidad. It provides a three years' course for young men between the ages of 17 and 22 who have completed a secondary education at a school in which Dutch is the medium of instruction. The College contains about 160 students, *i.e.*: takes between 50 and 60 new students each year. At the time of my visit 114 of the students were natives of Java and 16 of the outer islands taking the three years course, and the remainder of the pupils were planters or plantation staff. The College has a European staff of 7 Lecturers or Professors all of whom possess scientific degrees, and there is an additional whole or part time European staff of 9. Approximately 70 per cent. of the students who have taken the full agricultural course have entered Government service under the Department of Agriculture, the remaining 40 per cent. being engaged either on European plantations or on agriculture on their own account. This College was founded in 1913.

Below this College there are two Agricultural Secondary Schools, one established at Soekabumi in 1912 and the other at Malang in east Java, founded in 1919. These schools take pupils at approximately the age of 15. In Soekabum School there are at present 112 natives of Java and 10 from the outer islands. The course at each of these Agricultural Secondary Schools lasts two years.

In addition to these two Secondary Schools, where the medium of instruction is Dutch, there are 8 upper primary vernacular agricultural schools in different parts of the Island where native agricultural assistants can begin their scientific training in their vernacular. In addition to these schools of agricultural education there is a Veterinary College at Buitenzorg, established in 1907. Pupils enter any time after the age of 17 years and take a four years' course. There are at present 47 students, viz. : 29 from Java and 18 from the outer islands. These institutions collectively provide the personnel for the various grades in the agricultural extension service whose activities are observable in every corner of the Island.

Nothing is more striking than the high quality of the ordinary peasant cultivation, not merely on the irrigated areas but even up the mountain sides above the irrigated areas where the other native crops are grown. In the ordinary village gardens the use of green manures, the rotation of crops and all the latest devices for preventing soil deterioration and soil erosion, can be seen being practiced and it was clear that the general high standard of agriculture throughout Java could never have been attained had it not been for the early establishment of these various educational institutions turning out a continuous supply of local men with the necessary scientific and technical qualification.

After this somewhat cursory review of agricultural activities in Java I turn to Malay. The Department of Agriculture was not founded until 1904. The Rubber Research Institute maintained by the rubber industry has only just begun to function and is a product of the last two years. It will be seen that Java has had an immense start in time alone. The headquarters of the Agricultural Department in Malaya are at Kuala Lumpur in the Federated Malay States, where the offices and laboratories are situated in very small crowded and ill-equipped buildings. For the first 18 years the experimental plots were on a small scale and in the neighbourhood of the laboratories, but since 1921 the Agricultural Department has opened up a new large experimental station some 17 miles distant from the headquarters at a place called Serdang. It is on a considerable scale and embraces 1,000 acres, but it has, as yet, no laboratories and the scientific staff continues to work in Kuala Lumpur. Serdang is really only beginning its potential usefulness but at least it illustrates the variety of crops which can be grown at the lower altitudes in Malaya.

In addition to this the Department has a station in Malacca, and a station in the north of Perak, for the selection of pure line strains of rice. There is also a small coconut research station at Klang in Selangor. It has a few field officers in the Federated Malay States, and in Kedah and Jahore, but there are as yet no representatives of the Agricultural Department in the States of Kelantan and Trengganu. There

is no agricultural school but a Committee has recently reported (1927) in favour of the early establishment of a school of agriculture at Serdang. Paragraph 2 of their report reads as follows :—

"We have been impressed by the frequency with which the establishment of a school for agricultural education in Malaya has been urged both by the Agricultural and Educational Departments during the last 12 years. It has perhaps been on account of the difficulty ofdeciding on the scope of such an institution, that the schemes have hitherto failed to materialise."

Great as is the need for improving both the quality and quantity of agricultural research work in Malaya I feel that the establishment of a school of agriculture, particularly for the training of Malay and other assistants, for the Agricultural Department has a prior claim to consideration. The Department of Agriculture in British Malaya has from time to time suffered from the loss of some of its best men. These, after appointment, have abandoned service and gone into private employ, notably on the large and progressive European rubber estates in the Dutch Island of Sumatra, where they have been conspicuous in their work for the scientific development of foreign plantations, notably in the introduction of bud grafting.

The success of the rubber industry in British Malaya is due not so much to any efforts in the direction of scientific agriculture, though these are beginning on a few of the more progressive estates, such as Prangbese near Kajan, on the Dunlop Estates in Malacca and Johore, and on the American (Harvard) Estates in Kedah, but rather to the fact that rubber has been planted on new virgin soil freshly cut out of jungle in climatic conditions which are ideally suited, in many respects far better suited than are either Java or Ceylon, to the successful cultivation of the tree. Malaya has the great advantage of complete absence of winter or of a dry season with the result that the wintering period when the leaves of the Hevea tree (one of the only deciduous trees you see growing in Malaya) are off the trees, is remarkably short. It is perhaps very largely owing to the considerable profits that have been made in recent years out of rubber in Malaya that so little attention has been devoted to the development or the introduction of any other crops. But the future of plantation rubber with its high overhead charges for European personnel, for local agents, visiting agents, commissions, directorates in London and elsewhere, and competition with the native industry now rapidly expanding in Sumatra, Borneo and even Malaya, must, in my opinion, depend upon the superior scientific treatment of the crop on the European plantations. In fact whereas the cost of production in the native industry amounts to little more than the cost of tapping, the European estates have many other charges to bear, and it is only by getting very much higher yields per acre and the maintenance of the trees in superior health by means of manuring and soil conservation that they will be able ultimately to compete. All these factors will, no doubt, receive the attention of the Malayan industry now that it has its new Rubber Research Institute but in the matter of planting of selected trees with their high yielding capacity Java, Sumatra and Ceylon are already ahead of Malaya.

As I have already stated in Ceylon the largest area under any one crop is that devoted to coconuts. Though the area is placed at 890,000 acres this is probably an under-estimate if all the trees inter-planted with fruit trees and other crops on native holdings are taken into account. The annual harvest of coconuts in Ceylon is now well over 1,000,000,000 nuts per annum, and more has been done in Ceylon to organise the production and export of all the coconut bi-products other than the ordinary copra, than in any other part of the British Empire. The Legislative Council of Ceylon has before it at this moment a proposal to establish a specific coconut research scheme, financed by a cess upon the industry, and to devote special attention to the genetical factors in connection with the improvement of this crop.

Of the area planted with rubber in Ceylon approximately 50 per cent. is owned by European Companies and 50 per cent. by natives of Ceylon, *i.e.*: Sinhalese, Tamils and others. Among the latter there are a considerable number of small holdings. Undoubtedly mistakes have been made in Ceylon in attempting to plant rubber at too high an altitude. Even under favourable rainfall conditions the growth of the rubber tree at altitudes over 1,500 feet is slow and the yields of rubber per acre are much less than at lower altitudes. Diseases such as oidium and secondary leaf fall in rubber and physiological defects such as brown bast are more common on the higher plantations. In fact it is doubtful whether the upland estates can ever compete with plantations more favourably situated in the lowlands. The night temperature more than anything else seems to delimit the rubber belt of the world. The three diseases I have referred to are almost entirely the effect of malnutrition or hostile environmental characteristics, and their danger is lessened if the general health of the tree can be adequately maintained. In fact the best method of combating such diseases is the maintenance of the general health and vigour of the plant.

The most significant contrast between rubber in Ceylon and Malaya is seen in the general use throughout Ceylon of cover crops for the prevention of soil erosion. This has largely been the work of the last six years and now it is rare to see a rubber plantation in Ceylon without a green cover crop of *dolcia hosei* (vigna) or of centrosema. It is equally rare to see any old established rubber plantation in Malaya, where cover crops have been introduced. The Agricultural Department in Malaya have agitated for the introduction of cover crops for the past twenty years but it is only recently that the Directors of the various companies and the visiting agents have got over the "clean weeding" policy of old times. During the last

three years it is only fair to say that 70 per cent. of the new areas planted up with rubber in Malaya have been planted with cover crops. In fact one of the British owned estates in Java has been doing quite a good business in exporting cover crop seed from Java to Malaya. The object of the cover crop is, of course to preserve the tilth and humus in the top soil from being washed away by the tropical rains. If this most valuable part of the soil is washed away the yield of rubber goes down and the tree is generally weakened. On occasion it has been found difficult to introduce the necessary cover crop owing to the heavy shade of a long established rubber plantation, but by combining the introductions of the cover crop with a dressing of artificial manures it is usually possible to get the cover crop well established in one or two years.

A great deal of attention is being paid nowadays in Ceylon to the use of manures in the production of all tropical crops, particularly tea and coconuts and they have also been introduced by the more progressive rubber planters. Probably the most remarkable results of these more scientific methods of cultivation adopted in Ceylon can be seen on the tea estates, and I was furnished with a series of very remarkable figures showing the increased yields of tea per acre due entirely to the use of green manures and chemical manures over a period of years. A great deal of experimental work has been done in this direction both by the Department of Agriculture and by the planters themselves, and a great deal of experimental work is needed before the most commercially profitable mixtures and chemical manures in particular, can be ascertained. This work is even more complex in rubber than it is in the case of tea.

In the cultivation of coconuts *Tephrosia candida* is the most popular green manure crop. In many of the tea plantations a single species is made to serve both the duty of shade tree, protection against erosion and green manure crop, and nothing is more noticeable in Ceylon than the widespread introduction of the leguminous tree from Nicaragua in Central America, known by the botanical name *Gliricidia Maculata.*

A leguminous green manure has a two-fold virtue. When the plant is growing its roots form nodules in the soil which have the effect of storing nitrogen in the soil, while its leaves and branches can be cut annually, thrown on the ground and finally dug in to form a mulch rich in nitrogenous humus. I saw a greater variety of these green manure crops being tried out in different altitudes and in different cultures in Ceylon than in Java where the green manure crop most universally seen is *crotolaria.* In this connection it must be remembered that under tropical conditions nitrogen obtained from artificial chemical manures is very easily lost by leaching and green manuring has physical as well as chemical benefits to provide. Incidentally some very important work is being done by the Agricultural Chemists at Peradeniya on the nitrification of tropical soils.

In Ceylon scientific work is concentrated at Peradeniya near Kandy. At Peradeniya there are situated :—

(1) The Royal Botanical Gardens (146 acres).
(2) Central Economic Station (547 acres).
(3) Headquarters of the Director of Agriculture.
(4) The Central Laboratory and the large and well-equipped block of laboratories.
(5) The Agricultural School.
(6) The headquarters of the Rubber Research Institute.

Peradeniya lies at an altitude of 1,500 feet above sea level, has an annual rainfall of 88 inches distributed over 170 days, and a mean temperature of 76°. It is a little high for rubber and a little low for tea. However both these crops can be successfully if not ideally cultivated there.

The new Tea Research Station is at Nuwara Eliya at an altitude of about 6,000 feet near where the bulk of the high quality tea of Ceylon is grown. Rubber research work is being carried out partly south-east of Colombo at the Culloden Estate and partly at the old Botanical Gardens at Reneratgoda about 18 miles north-west of Colombo. It is of interest that this garden was established in 1876 for the reception of the original plants germinated at Kew from the rubber seeds brought by Sir Henry Wickham from the Amazon. A group of the original trees still stands and among them is the famous Heneratgoda No. 2, which, so far as I am aware, is the highest yielding rubber tree so far known. This tree gave over a continuous tapping period of nearly five years an average yield of 96 lb. of dry rubber per annum. I dare say this figure does not mean much to you. The average estate tree on an ordinary plantation yields about 4 lb. of dry rubber per annum. In fact the ordinary rubber plantation expects to get between 350 and 500 lb. of rubber per acre per annum. An acre planted with 80 H. No. 2 trees will give a yield of over 7,000 lb. per annum.

The next important point to note is that trees grown from the seeds of H. No. 2 are rarely high yielders. In fact the yield of the vast majority of the seedlings whose mother tree is H. No. 2 and whose father is unknown, is not above that of the ordinary estate tree. Everything points to the fact that though Sir Henry Wickham was fortunate in bringing some seeds from the Amazon which proved to be very high yielders, the seeds themselves collected in the forests of Brazil were the result of generations of cross fertilisation. Since rubber has been established in the Far East this process of promiscuous cross fertilisation has gone on for an average of about seven generations with a result that all the various genetical factors have become inextricably mixed and nowadays there is no guarantee that any large proportion of the seeds of a high yielding mother tree even when crossed with the pollen of another high yielding tree will result in high yielding seedlings. In fact all the evidence goes to show that even with the most approved and carefully controlled

methods of seed selection the vast majority of seedlings will be the ordinary low yielding tree. It is this fact that has compelled scientists to seek some other method of propagating high yielding rubber trees, and the device invented by the Dutch and now increasingly practised in Java and Sumatra is the method of budgrafting —to my mind by far the most important and significant development that has ever taken place in the history of the rubber industry. The two principal estates on which budgrafting was first introduced are the United States Rubber Plantations and the A. V. R. O. S. Rubber Experimental Station, both in Sumatra. The Director of the Research at the former, Mr. J. Grantham, formerly in the employ of the Malayan Department of Agriculture, started in 1917 estimating the individual latex yield of four and a half million trees on a single estate of 27,000 acres. The results obtained by 1921 were :—

Class I—Est. Av. Yield of Dry Rubber 14 lb. or over was for	1,293 trees
Class II—Est. Av. Yield of Dry Rubber 10 lb. or over was for	31,487 do.
Class III—Est. Av. Yield of Dry Rubber 7 lb. or over was for	198,411 do.
Remainder (about 3 lb.) ..	4,268,809 do.
Total	4,500,000 do.

In 1923, 250 of the best trees in Class I were selected for daily records of yield in dry rubber. The best single tree out of the four and a half million examined gave a yield of 55 lb. in 1924 and 52 lb. in 1925 ; while 17 trees in 1924 and 21 trees in 1925 exceeded 30 lb. The above trees are all in ordinary Plantations of 80 to the acre.

The United States Rubber Plantations began budgrafting from selected mother trees on an area of 10 acres in August, 1918, and on a larger scale in 1920. Tapping of 60 budded trees began in May, 1922. The A.V.R.O.S. General Experimental Station began planting out budded areas in 1918 and 1919, and the first published results, given by Dr. Hensser in *Archief voor de Rubber Kultur*, January, 1924, are based on tappings made in February, 1923. The "Bandons Datar Company has already published results of 700 budded trees of different clones all planted in 1918.

But budgrafting is not a simple process. For one thing not all high yielding trees will transmit their high yielding qualities even by the method of budgrafting. Further, there are other factors such as vigour and the general character of the plant which must be borne in mind in addition to high yields of rubber. Further, not all scions will take successfully on to all stocks and the scientific relation of stock to scion has yet to be worked out. I have heard it stated in Malaya that there are grounds for believing that grafted rubber trees are more liable to disease than seedlings. I cannot find any scientific evidence for any such statement. One thing, however, seems to me to be fairly clear, if, as seems likely, by the method of budgrafting the average yield of rubber per tree can be immensely increased then the tree will probably require more food, and the introduction of budgrafting will have to go hand in hand with manurial experiments of a far reaching kind.

I shall be dealing with all these points at some considerable length in my report and I wish to return to the work of the Agricultural Department in Ceylon.

Far wider effort is being made in Ceylon than in Malaya in the selection of higher yielding strains of rice. This work is going on at two main stations and 19 other subordinate stations who are working out the various types of seed most suited to the different types of soil, the different elevations and the different maturing periods requisite in the Ceylon rice industry.

Further the Agricultural School at Peradeniya is quite first class. It has a dairy farm as well as its own cultivable plots while a good deal of the teaching is done actually in the secondary experimental station of the Department. This school was established in 1916, it is residential and open to pupils of over 17 years of age. Of the 180 students who have passed through the school 60 have entered the service of the Agricultural Department, the remainder have gone on to estates. In addition to the agricultural students there is a one-year course in agriculture for selected vernacular school teachers. In this way Ceylon is rapidly building up its own agricultural extension service and the selection of Kandy as the site of the proposed University of Ceylon has been largely influenced by the importance of the early establishment of a Faculty of Agriculture at that University. Finally I should like to say that Ceylon is particularly fortunate in possessing Mr. Stockdale as its Director of Agriculture. It is very largely due to his efforts that Ceylon is in the forefront of modern tropical agriculture. Java started early and has had more men and more money engaged in agricultural research and its application. Further the scientific staff in Java had had the full backing and support both of Government and the planting community. Successful management of plantations in the tropics now requires two elements, viz.: skill and understanding in the management of labour and a real knowledge of agricultural sciences. In the former we frequently excel, in the latter still have much to learn.

We have to acknowledge with many thanks the receipt of Ferguson's 1928 Ceylon Directory which contains 2,463 pages and is a very comprehensive guide to facts and figures about the Colony. Part I records much useful information of a historical, official, statistical and commercial character, while Part II is a general directory of addresses of persons residing in Ceylon.

THE IMPERIAL COLLEGE.

Its History and Development.

By C. Y. Shephard, B.Sc. (Econ.).

The Imperial College of Tropical Agriculture, or, as it was originally named, the West Indian Agricultural College, was formally opened in 1922. Its history may, however, be legitimately antedated to 1897, when the West Indian Royal Commission was appointed by the late Joseph Chamberlain, then Secretary of State for the Colonies, to report on the conditions and prospects of the sugar-growing industry, and to suggest measures calculated to restore and maintain the prosperity of the colonies concerned. What has proved to be the most far-reaching effect of the Commission was the formation of the Imperial Department of Agriculture for the West Indies, supported by Imperial funds, with Dr. (now Sir Daniel) Morris as its Commissioner, and its headquarters in Barbados. The small staff of highly competent specialist officers was able by constant visits to the Windward and Leeward Islands to supplement and direct the work of the augmented local Botanic Stations. To elaborate in detail the work of the Department would be to write the economic history of these islands during the present century. Among its material accomplishments may be instanced the introduction of the Sea Island cotton industry, which saved several of the smaller islands, and still forms an integral part of their economic structure; the stimulation of the production of seedling sugar-canes—commenced in the West Indies by Bovell and (late Sir John) Harrison—which have been the salvation of the world's cane-sugar industry; the movement towards the manufacture of sugar in large central factories; the improvement of native stock; the investigation and control of insect pests and diseases; experiments in agricultural legislation, and the introduction of co-operative credit, production, and marketing. Broadly the result may be described as the re-organisation of agriculture upon more diversified and scientific lines, and the Department may claim to have played an important part in restoring the prosperity of the islands.

Further than this, the Department succeeded in instilling confidence among the planters and peasants, and enlisted their interest in scientific agriculture; indeed, without the full co-operation and assistance of the agriculturists the results of the Department could not have been achieved. But the more important results of the Department lie in its reaction upon agricultural organisation throughout the British Crown Colonies. The Imperial Department was, in fact, the origin of the modern agricultural department, and many of its former officers are to be found in posts of responsibility throughout our tropical possessions.

Such, briefly, was its history till the end of the War. The British West Indies then clearly recognised the need not only for scientific specialists and administrative officers, but also for scientifically trained planters. The Imperial Department had, from an early stage, performed some teaching work among boys, planters, and specialist officers, and even before the war Sir Francis Watts (then Dr. Watts, who succeeded Sir Daniel Morris as Imperial Commissioner) had formulated a scheme for an Agricultural College which envisaged with remarkable clarity not only its present organisation, but also the lines upon which its future must develop. A Committee appointed by Lord Milner resulted in the foundation of the West Indian Agricultural College in Trinidad, with the late Sir Arthur Shipley as Chairman of the Governing Body, Sir Francis Watts as Principal, and the officers of the Imperial Department as its teaching staff. It is characteristic of the relations of the planter, the Imperial Department, and the College, that the planting community of Trinidad and Tobago voluntarily taxed itself to the extent of £50,000 to assist in the foundation of the College, while this and every other British West Indian Island (with the exception of Jamaica), and British Guiana and British Honduras contribute towards its annual revenue. The College absorbed the functions of the Imperial Department of Agriculture, for which it received a diminishing Imperial grant, which expired in 1927.

By the time the College had been established the shortage of agricultural officers throughout the British Tropics had become acute. Not only were demands for such officers from departments and planting companies becoming more extensive and intensive, but also the supply, due to normal and war wastage, the stoppage of recruitment, and the competition of industrial concerns, had diminished. The situation was ameliorated to some extent by the exodus of senior, and diversion of junior, officers from India to the Colonies, following the reforms and progressive Indianisation of the agricultural service, but it was clear that the situation would become aggravated unless steps were taken to stimulate recruitment. It is greatly to the credit of the Empire Cotton Growing Corporation, and an example which might, with advantage, be followed by similar organisations, that it sought, by offering scholarships, to repair the shortage it was partially responsible for creating. The West Indian Agricultural College being the only institution of its kind in the tropics, it was naturally selected as the training ground for these scholars. With this change in outlook, and wider financial support, the title of the institution was changed to the Imperial College of Tropical Agriculture. The Colonial Office, observing the benefits of the Corporation's Scheme, followed its example, and men destined to serve in the Colonial Agricultural Departments are normally sent to the Imperial College for a portion of their training.

Coupled with this new demand came the desire for an institution at which fundamental research—with which the local Departments with their

more pressing and more local demands could not cope—could be carried on. The officers of the College, who had acquired a high reputation as research workers in the Imperial Department, began investigations connected mainly with cotton (now largely transferred to the Empire Cotton Growing Corporation's Research Station, Trinidad), bananas, and the agricultural and manufacturing aspects of cane-sugar production. The results already obtained, although severely handicapped by inadequate staff, funds, and land, have sufficed to indicate the great value of work of this nature. At the Imperial Agricultural Research Conference held last year at Westminster, it was resolved to found a chain of central research stations, of which the College would form the first link, supplementing the functions of the existing local Departments of Agriculture. The College is now working in conjunction with the Trinidad Agricultural Department and planters in endeavouring to evolve methods for the control of the froghopper which attacks the sugar-cane and annually results in heavy damage. The many sided nature of this problem, involving close co-operation between specialists and planters may well prove a classic in scientific agricultural investigation, even though the insect concerned is of only local occurrence. Thanks to the energy and foresight of Sir Francis Watts, the hearty co-operation of Mr. Geo. Moody-Stuart, who was also largely responsible for securing the initial financial provision for the College, and the generosity of the British Sugar Machinery Manufacturers, the College is now equipped with a sugar factory, embodying the latest machinery and capable of carrying on experiments on a small commercial scale, as well as giving practical instruction. Students of sugar technology are no longer compelled to receive their training outside the British Empire. An attempt is being made to breed a variety of bananas which, while possessing the desirable qualities of the Gros Michel, is not susceptible to "Panama disease," which has invaded most of the banana-producing areas of the world. This work is being extended by a grant from the Empire Marketing Board, and a cold storage plant is in course of erection at the College to test the carrying qualities of immune varieties. The College scientific officers are also investigating pests and diseases of coconuts, limes and other tropical crops. A scheme is under consideration for a comprehensive investigation of the cocoa industry with a view to improving yields and increasing the profitableness of existing areas in order to counteract an anticipated shortage of cocoa. While it is impossible to outline all the investigations being carried on it is hoped that the examples given will suffice to indicate the importance of the College, not only to the whole of the British Tropics, but also to the temperate countries, and particularly the United Kingdom whose industries and food supplies are becoming increasingly dependent upon tropical sources.—(Reprinted from *The Outlook*, Vol. LXI, No. 1583.)

TROPICAL AGRICULTURAL RESEARCH.

Tropical Agricultural Research in the Empire.—With special reference to Cacao, Sugar-Cane, Cotton and Palms. By C. A. Barber, sc.d., c.i.e., Empire Marketing Board. Publication E.M.B. 2. H. M. Stationery Office, London, 1927.

"The development of Tropical Agriculture is of the utmost importance, not only to Great Britain but to the temperate Dominions of the Empire, since the prosperity both of industry and agriculture in temperate climates depends upon the scientific exploitation of tropical resources. Taking the long view, tropical development is more and more becoming the mainspring of economic progress, and the enormous tropical area comprised within the British Empire only needs the continued application of scientific research to maintain and even increase the striking advances which have taken place in recent years."

Thus writes Mr. Ormsby-Gore in a preface to Dr. Barber's paper, which is an outline, prepared at the request of the Empire Marketing Board, of the research which has been done, and which needs doing, on the four crops mentioned in his sub-title. These crops have been chosen as illustrative of general principles, and the detailed consideration of them is prefixed by a general discussion of what "Tropical Agricultural Research" implies.

Dr. Barber starts by pointing out that in the Tropics we have two contrasted forms of agriculture, the indigenous systems of the natives and those introduced by Europeans.

The former presents in different places an epitome of the stages of the evolution of the art, from collection of wild forest products, through garden cultivation to field cultivation in rural districts for the support of dwellers in towns. In all cases, however, the main consideration is provision for the needs of the local population. The problems to be faced in improving such native agriculture naturally vary with the stage of evolution reached, but in any case they differ from those relating to European introduced agriculture, where the aim is production for export. In the latter case the crops themselves are sometimes relatively new (rubber has only been in cultivation some 50 years), or at any rate new to the localities where they are being grown, and they are often long term crops rather than the annuals more usual in indigenous cultivation.

Speaking generally, Dr. Barber considers the support and improvement of native agriculture to be the duty of the Governments concerned, and the note may be added that the final training of the officers who are to carry on and extend this work in the future has already become the special duty of the Imperial College of Tropical Agriculture.

European agriculture in the Tropics, on the other hand, should in Dr. Barber's opinion be self-supporting, and with this as a general principle there can be no quarrel. But surely this statement of the principle is rather ambiguous: "There are many reasons why the planters should have complete control of the agricultural officers working for them, of which the most obvious one is that the work would be much better done, being overlooked and guided by those actually growing the crops and knowing intimately the lines along which improvement is needed."

Does Dr. Barber mean to imply that a piece of, say, cytological research will be more successful if the cytologist is told periodically by a body of practical planters what to do next? Of course he does not, but he should have made much clearer what he means by "complete control," especially in the next paragraph, where he goes on to tell us that in the sugar industries of Java and Hawaii "every detail of the agricultural research is under the complete control of the planters." We take this to mean simply that the planters, paying the whole cost of research (which, by the way, is given as £100,000 per annum in Java, and over half that sum in Hawaii) thereby "control" it rather more directly than as taxpayers they could "control" the operations of a Government Agricultural Service. It is safe to assume that, being reasonable men, they do not meddle with the technical details more than is absolutely necessary for financial administration.

In the long run, of course, the bulk of the cost of agricultural research, however it is administered, is usually paid by the agriculturists themselves, whether by direct cess or indirectly through taxes. It is only fair that it should be so, and equally fair that a measure of control should result from the payment. On the other hand, Dr. Barber's implied suggestion that all agricultural research would be better done by stations run co-operatively by the industries concerned seems premature on the evidence available.

He has, in fact, overlooked that class of research which is not localised in its application, and which needs long periods of time for its consummation. We have genetics particularly in mind, with special reference to perennial crops, but similar considerations apply to certain problems in other branches of agricultural science. Industrial Research Associations are in their infancy. It is certainly a lusty infancy, and remarkable results have already attended the efforts of more than one such organisation, but until an agricultural industry has run an Empire Research Association continuously and successfully for fifty years, maintaining its programme through periods of depression as well as in prosperity, it must remain unproved that this type of institution can handle to the best advantage long term research.

Meanwhile, we have another type of research organisation in the field, and one which has proved its usefulness, most particularly in the more difficult and "fundamental" researches, over and over again. In the Home Country we find that the major part of the research from which agriculture and horticulture are benefiting most has been done, not by stations under the direct control of farmers, nor by officers directly employed by Government, but by the Universities, which are independent bodies supported in part by both sides.

To elaborate the advantages which a University enjoys for the prosecution of the more technical pieces of necessary agricultural research is beyond the scope of this review, but it may be pointed out that in the Imperial College of Tropical Agriculture, an institution founded for teaching and research, and incorporated by Royal Charter, we have already in the Tropics the counterpart of the agricultural branch of a University, with similar advantages, and for this institution all the indications are that, properly supported, it can fulfil its functions at least as efficiently as any research station run by an industry. It is the tried type of organisation as against the untried, and time alone will show whether either has significant superiority to the other.

Dr. Barber goes on to define agricultural research as:—"The study of crops and their environment by an individual who has undergone a training in some appropriate science" and discusses the places of the trained agriculturalist with a general elementary scientific knowledge and the specialist in one particular branch of science. We agree that "the idea of severely separating these two classes of workers will inevitably break down in practice" but the agreement depends entirely upon the word "severely." Separation of specialists in central research stations from officers on administrative duties and what may be called local research, provided a close liaison be maintained between the two, is not only administratively desirable but essential to the efficient prosecution of research, and this point might well have been made. The emphasis placed on the value of one-crop officers, and on the necessity of laboratory workers touring frequently in the field, is entirely sound.

In stating the present position of tropical agriculture, Dr. Barber stresses the greatly increased consumption of tropical products during the last quarter of a century, and the economic factors leading everywhere to strenuous efforts to increase efficiency and get more out of the ground. He thinks that the balance of nature is being disturbed and the plants grown are becoming more delicate and liable to be unhealthy under the strain, and that mechanical cultivation is questionably as good as the old, slower hand methods. The reviewer would sum it up rather differently. It appears to him that the balance of nature has not been disturbed by modern methods of intensive cultivation as much as by the shameless and unabashed exploitation of tropical soils which has gone on since first the European started to plant them and is not yet

at an end, though sheer necessity is speedily bringing it to one. Land has in countless cases been cropped year after year and no return, or practically none, made to it, and if after half a century or more of this treatment it is worn out and cannot support healthy plants, the blame does not lie on mechanical cultivators or artificial manures. In sound agriculture the crop is interest and the fertility of the land capital, and the outstanding problem of the planter, at least in some parts of the Tropics, and probably in most, is to replace the capital drawn out along with the interest by his predecessors.

The crops chosen for detailed treatment represent both the great divisions of flowering plants, the Dicotyledons and the Monocotyledons, an annual and a perennial being chosen from each, and the principle of this choice could hardly be bettered, for there are fundamental differences between the problems which concern these four main groups even greater than the differences which occur between individual crops in any one group.

In his treatment of cacao, Dr. Barber is least happy. After describing the plant, he discusses former research, and everyone who has ever attempted the same task will agree with him that "after going through the mass of papers written upon the cacao plant, one feels a sense of confusion—much painstaking work that appears to have just missed the mark, and very contradictory views entertained and recorded in almost every direction." And yet a little later, he sums up—"We feel, anyhow, that we know a great deal about cacao, and can thus start a discussion of present day advances and views on a sounder basis."

As a matter of fact, much of the most reliable information which we have about the plant finds no place in this summary at all. Under the heading of "Recent Research" emphasis is rightly laid on work of the Trinidad Department of Agriculture, which has shown that the obtaining of increased yields is a horticultural question depending largely on the elimination of trees which are constitutionally bad yielders. But the precise meaning to be attached to the term "recent" is indicated by the statements that poor bearers cannot be cut out "because of the injurious influence of the sun on the soil and of the wind on the other trees" and because "it is idle to expect a seedling to survive when surrounded by a plantation of mature trees" and that on these accounts the development of water shoots is encouraged on poor yielders, in order that they may be improved by grafting on to these shoots. Experiments to compare this type of replacement with complete cutting out of the poor yielders and replacement by seedlings or budded plants on seedling stocks were laid down by the Trinidad Department of Agriculture in 1918, and it was very soon found that the latter method was preferable. Thus for nearly ten years now interest has centred on the promising results of budding on seedling stocks, but of this, and of the consequent urgent need for thorough investigation of the physiological interactions between stock and bud, and of the relative merits of different stocks and buds, there is unfortunately no mention at all.

On sugar-cane, Dr. Barber is a recognised authority, and his summary is well done. He mentions as requiring investigation the morphology of the plant, and especially of the root-systems, its physiology, and the formation and distribution in time and space of the different sugars present, a survey and classification of existing varieties, especially as a guide in the raising of seedlings, soil questions, including soil biology and manurial treatments, pests and diseases. Detailed discussion of seedling work is purposely omitted, but the three main lines of research are summed up as (1) the raising and testing of new cane seedlings (2) the thorough scientific overhauling of cultivation practices and (3) the control of pests and diseases.

The problems of cotton are likewise soundly treated, and due weight is given to the places especially of the entomologist, the geneticist, the physiologist and the agriculturalist in their solution.

As to the palms of which the coconut, oil palm and date are the most important, Dr. Barber rightly points out that in view of their long life history, and the absence of healing tissue, which rules out the horticultural practices applicable to cacao, the choice of variety to be planted is of special importance. He puts the collection of varieties into one place for study and survey as the first step necessary in future research, and also notes that it should be taken at the earliest possible moment. Morphological and physiological studies should be continued as well, together with investigations of pests and diseases, which have already received a considerable amount of attention. This seems to sum up the situation as well as it can be done.

In general, and apart from the points which have been specifically criticised, this publication is a commendable summary of the present state of knowledge concerning the crops treated, and serves to illustrate not only the particular problems which confront the officers working on them, but also the general principles upon which agricultural research in the Tropics is conducted, and the results which are likely to accrue from any extension on Imperial lines of the facilities for such research.

E. E. C.

CEYLON'S total shipments of cocoa for 1927 amounted to 78,885 cwt. which is 12,498 cwt. more than the previous year's figures. Shipments to the United Kingdom and the United States of America show an improvement of 5,447 cwt. and 3,561 cwt. respectively while export to the Philippines decreased by 3,145 cwt., as the regulations which were in force in Manila for the fumigation of ships from ports where plague existed hampered business with these Islands.—(*Chamber of Commerce Journal*, Vol. LV, No. 742.)

TROPICAL WORLD NOTES.

Sierra Leone.

The value of the Colony's imports in 1927 showed an increase of £4,000 odd, though there was a decrease in the export of specie. Exports of ginger, from which product much was hoped, declined to 27,354 cwt., compared with 55,265 cwt. in 1926. On the other hand, the export of cocoa showed an appreciable increase (77 tons against 41), owing to the efforts of the Government to encourage its cultivation in the Colony's southern province. There was also a considerable increase (over 1,400 tons) in the quantity of kola nuts exported, though no proportionate increase in value. Exports of piassava increased in value as well as quantity, new markets having been developed in South Africa and Canada.—(*The Times Trade and Engineering Supplement*, Vol. XXII. No. 516.)

* * *

Java.

A report prepared by the Commercial Agent at Batavia (Mr. H. A. W. Bluett) states that 1927 was a year of steady commercial progress, and was free from the patches of trade depression which was so noticeable in 1925 and 1926. The percentage values of total exports of sugar rose from 35.9 per cent. in 1926 to 45.3 per cent. in 1927, of tea from 9.5 per cent. to 9.8 per cent. while coffee remained at 3.7 per cent. for both years and Rubber and Gutta Percha fell from 21.4 per cent. to 14 per cent. The 1927 sugar crops totalled 2,360,135 tons, the area grown being 185,635 hectares. The Vereeniging Tea Expert Bureau place the Dutch East Indian tea crop at 65,600,000 K.G., an increase of 3,650,000 K.G. over 1926, which is applicable only to the Java crop; the Sumatra crop being the same as in 1926. Fine teas were scarce as the normal dry weather months were much broken with rains, but the general quality of the teas was good on the average.—(*Produce Markets Review*, Vol. XCIV, No. 3185.)

* * *

Dominican Republic.

According to the latest Report of the Dominican Customs Receivership, the total value of Dominican exports for 1927 was $31,178,769 as against $24,895,871 for 1926, a net gain of $6,282,898, or 25 per cent. A better price received for sugar, and large crops of cocoa and tobacco coupled with good prices were chiefly responsible for this increase.

During the year under review 295,896 tons of sugar were exported valued at $16,668,385 which when compared with 337,653 tons ($14,699,613) in 1926 shows a loss in tonnage of 41,757 but a gain in value of $1,968,772. Sugar is the staple product and since 1914 has formed more than 50 per cent. of the total value of all exports.

The 1927 cacao crop which amounted to 26,513 tons represented a gain in tonnage of 6,429 and in value of $3,645,362 or 95 per cent. in excess of the price received in 1926. Tobacco exports showed the greatest individual gain over the preceding year and 20,298 tons, valued at $2,582,486 were exported as compared with 9,754 tons with a valuation of $1,192,026 for the previous year, an increase of 10,544 tons and $1,390,460 in value or 117 per cent. over the amount received for the crop of 1926. Amongst other exports mentioned in the Report, coffee, sugar cane, molasses and corn showed decreases.

* * *

Gold Coast.

Colonial Report (No. 1386) on the Gold Coast which includes the Gold Coast Colony, Ashanti and the Northern Territories states that the total value of external trade for 1926-27 was £22,390,676 as against £20,672,842 in 1925-26. The satisfactory result is mainly attributed to the exports of cocoa which represented about half the world supply and the value of which amounted in the year under review to £9,181,235 compared with £8,222,263 in 1925-26. The following export figures are given for the principal agricultural products:—

	1925.	1926.
	£	£
Cocoa	8,222,263	9,181,235
Kola nuts	282,773	259,479
Palm kernels	115,257	125,556
Rubber	33,946	53,473
Palm oil	43,624	52,283
Copra	30,704	33,482
Fibre	6,995	18,193

It will be seen from the figures that in addition to cocoa, palm kernels, palm oil, copra and cotton all showed improvement. For the second year in succession there was a decrease in shipments of kola, maritime exports falling from 13,656,162 lb. in 1925 to 12,474,028 lb. in 1926. It is probable that unfavourable weather was the main cause of this decrease but increased exports overland to Nigeria *via* the Northern Territories may also have contributed to it. Nearly all the kola shipped from Gold Coast ports is consigned to Nigeria, where it is meeting with increasing competition from kola exported by Sierra Leone.

The Government Sisal Plantation near Accra made good progress during the year, exporting 456 tons of sisal hemp valued at £18,193. The introduction of improved machinery has enabled the plantation to market fibre of first grade quality.

The cattle trade is mainly in the hands of Africans, but a number of French and Syrians also participate. The cattle come from French country to the North of the Gold Coast and are brought down on the hoof along well-defined caravan routes and sold at distributing centres in the North for breeding and in the South for slaughter.

Nigeria.

The Colonial Report on Nigeria (No. 1384) for 1927 states that the total value of the Colony's trade during the year was £31,653,000 or £716,000 higher than the previous year. The following figures (for the years 1924-1927) are given for the principal agricultural products which represent just over three-quarters of the total export trade :—

	1924		1925		1926		1927	
	Quantity Tons.	Value. £	Quantity Tons.	Value. £	Quantity Tons.	Value. £	Quantity. Tons.	Value. £
Palm kernels ..	252,847	4,461,482	272,925	4,937,450	249,100	4,440,452	256,967	4,574,191
Palm oil	127,083	3,944,340	128,113	4,166,096	113,267	3,616,159	113,305	3,617,332
Cocoa ..	37,204	980,402	44,705	1,483,764	39,099	1,366,016	39,152	1,968,612
Ground nuts ..	78,266	1,461,448	127,226	2,394,251	126,799	2,342,739	90,772	1,633,896
Cotton lint ..	92,770	762,427	132,724	797,463	179,315	1,182,050	101,854	611,124

Palm oil and Palm kernels.

It will be seen that both palm oil and palm kernels exports reached a high point in tonnage and value and although not quite as satisfactory as in 1924 and 1925 the quantities were substantially above the average for the last six or seven years. The market was generally speaking not favourable, prices offered for the former article ranging between £20 and £22 per ton, while those for the latter were in the neighbourhood of £14.

Cocoa.

Cocoa showed very little increase on the previous year in spite of uniformly good prices. So far as can be judged the underlying annual rate of increase in production, due to young trees coming into bearing, is at present about 1,500 tons per annum. In the present main cocoa belt in the western part of the Southern Provinces, cocoa planting continues steadily, but does not seem to have been accelerated by the recent high price, which has, however, greatly helped the efforts of the Agricultural Department to stimulate cocoa planting in other parts of the Southern Provinces. The work of improving the quality of Nigerian cocoa through a dual programme of produce inspection and co-operative demonstrations of fermenting continues to give good results, and the special grade of cocoa produced at the co-operative demonstrational fermentaries continues to command a high premium.

Ground-nuts.

Ground-nuts showed a falling off of over 36,000 tons as compared with last year. For this there are two reasons, the first being that prices were so low that the producer beyond a certain distance from the markets found it an unprofitable proposition owing to the heavy cost of animal transport, and the second that owing to a general shortage of local foodstuffs a fairly large proportion of the crop passed into local consumption. There seems to have been an expansion of planting in the area in the east of the Sokoto Province, where the effect of the road is beginning to show itself in opening up trade.

Cotton lint.

Cotton lint showed a somewhat disappointing fall, which can be attributed to much the same causes which affected the ground-nut crop. Plantings in the Northern Provinces have been restricted by the exceptionally heavy planting of grain crops, so that although the yield per acre promises to be normal, the export in the current season is tentatively estimated at only 28,000 bales. However, the farmers do not seem to have lost confidence in cotton growing. The building of the new railway has had an important effect, even although it was only partly opened last year and that only to Funtua. The remission of railway freight, and the reductions of sea freight and ginning charges that were thereby secured, all helped. The production of native cotton for export in the "middle" and Southern Provinces amounted approximately to the same quantity of 11,000 bales, at which it has stood for the last three years. Increase in production awaits an improvement in quality and in 1926-27 the work of the Agricultural Department in this subject had reached the stage that certain strains of improved indigenous cotton had been brought to a state approaching purity, through several years of continuous self-fertilisation and scientific selection by modern methods. Two "sister" strains had been found, in two years' tests, to be reliably good yielders, and rather more resistant to some diseases than the ordinary native cotton.

Hides and skins.

In the trade in hides and skins, improved methods of preparation have resulted in greatly increased prices.

CATTLE IN INDIA.

Cross-Breeding and Grading.

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IT has long been an understood fact that cross-breeding as well as in-breeding, when used as a regular practice, is detrimental. Our master breeders used both these methods only as a means to an end of the establishment of our present-day breeds of cattle of the West. The same must be done if we wish to establish a breed of cattle in a short period of time which will be supreme in milk-producing and disease resisting qualities. In general cross-breeding is defined as the mating of individuals which are not related, but as a rule cross-breeding means the mating of individuals belonging to different breeds or the union of animals belonging to different species.

As in-breeding tends to simplify the germ-plasm and strengthen the powers of transmission, cross-breeding tends to weaken the prepotency and complicate the elemental constitution of the hereditary substance. Crossing has a tendency to break up established characters. It destroys combinations of characters which have long existed in the strains and which under the system of pure breeding have behaved in a manner like unit characters in transmission. Because of this, cross-breeding cannot be carried on indefinitely. It does, however, serve a good purpose in the starting of a new breed. The very fact that crossing disturbs the balance of characters and brings about recombinations in the germ-plasm gives it a peculiar value in causing variations to appear.

The breeder who is working with pure-bred animals which owe their purity of breeding to a long period of careful selection by skilful breeders cannot hope to cause any great degree of improvement. Pure-bred animals are already improved. About all any breeder working with pure-bred animals can do is to select out the highly desirable strains from those of lesser value already in the breed. But, as Johansen has shown, there are very definite limits beyond which the improvement of pure lines cannot go. If Indian breeds could be improved to the high degree of efficiency of the Western breeds in a reasonable length of time then pure line breeding would be well worth while. There may be three or possibly four indigenous breeds which could be bred to a fairly high degree of milk-producing efficiency in a reasonable length of time and this should certainly be done, but it is very doubtful that any Indian Breed will reach the high degree of efficiency of our major dairy breeds of Europe. Marked improvement must come through variation. Crossing is a common cause of variation. Variations which appear as the result of crossing may be desirable or undesirable. Desirable variations may be perpetuated by in-breeding and a new and valuable quality may be secured in this way.

There are two methods that may be followed after the first cross. The first method is the practice of grading after the first generation from two different breeds have been attained. The continual mating of pure-bred bulls to the first generation and to all the generations that follow will gradually develop a type identical to the breed the sires represent.

The second method is the practice of again crossing members of two separate families which are the first generation of two separate breeds. By applying Mendelian principles, which will differentiate the qualities of an animal and will determine their behaviour in transmission, the practical breeder will then carry on breeding methods upon the principles of segregation and dominance which are the foundation stones in the theory of Mendelian inheritance. Just a start in this second method has been made at the Lucknow Military Dairy and some very hopeful results have been reached so far. In this article, however, we will take up what has been accomplished through the first method at the Lucknow Military Dairy. Colonel Matson, Assistant Controller of the Military Dairies of the Southern Circle, has very kindly allowed me to make use of this information in any way for the advancement of breeding in India.

The first method was the method adopted in America. The Americans benefited by all that Europe built up through scientific breeding. They imported pure bred animals from Europe and mated them to native or un-improved animals. By the continuous use of pure-bred sires many high-producing animals of different breeds were established. This method unfortunately has proved unsuccessful in India as far as the Ayrshire is concerned. This fact is well recognised by the Military Dairy authorities who have done the most extensive work in cross-breeding in India. The main reason for the failure of the Ayrshire is due to the fact that it has not the characters which will blend with the characters of the Indian breeds on which it has been tried in the making of a progeny which will have constitution as well as good milking qualities in the second and third generations. Just how far this will apply to all the other European breeds is yet to be seen. However, it may be said that the Holstein-Friesian breed has so far surpassed the Ayrshire breed.

The three-quarter Ayrshire is very inferior to the half-bred Ayrshire and the seven-eighth Ayrshire is a hopeless animal both from the point of breeding as well as a milk producer. The three-quarter Friesian has proved to be a superior animal to the half-bred Friesian. Just how far the Friesian can be used for grading-up purposes is not yet known. The seven-eighth Friesian-Hariana grades are proved to be animals of good constitution and good milkers. Colonel Matson showed me many cases at the Lucknow Military Dairy to substantiate the above statements.

A cow in the Lucknow herd named Carnation has twenty-five-thirty-two European blood, of which twenty-four-thirty-two is Friesian and one-thirty-two Shorthorn. The remaining seven-thirty-two is Hariana. She has an excellent dairy conformation, a good constitution, and gave 10,000 lb. milk during her first lactation period at three years of age. Carnation's granddam, on her dam's side a one-eighth Shorthorn-Hariana cow, only gave an average of four pounds of milk per day, which goes to show that the pure-bred Friesian sires in the third and fourth generations were responsible for this excellent animal. It will not be surprising if Carnation makes a record in milk-production for all India at the end of her fourth lactation. It is doubtful if any three-year old cow in her first lactation has done so well, up to this time. Carnation's half sister, Gwendolyn, has twenty-five-thirty-two European blood, sixteen-thirty-two of which is Ayrshire, eight-thirty-two Friesian, and one-thirty-two Shorthorn. The remaining seven-thirty-two is Hariana. She has a very poor constitution and gives a very small amount of milk. Colonel Matson attributes this to the Ayrshire blood.

A fairer comparison, however, between the Friesian and Ayrshire breeds can be shown where both breeds were crossed to the same Indian breeds and where only two lines of blood were used in both cases. The half-bred animals in both cases are always good, although the Friesian half-breds invariably give more milk than the Ayrshire half-breds.

The Friesian-Hariana half-breds and grades average 10,000 to 15,000 lb.

The Ayrshire-Hariana half-breds and grades average 3,000 to 9,000 lb.

The Friesian-Sahiwal half-breds and grades average 8,000 to 10,000 lb.

The Ayrshire-Sahiwal half-breds and grades average 3,000 to 9,000 lb.

The three-quarter and seven-eighth Friesian-Hariana and the seven-eighth Friesian-Sahiwal always proved to be far superior in constitution and in milk production to the three-quarter and seven-eighth Ayrshire-Hariana and the three-quarter and seven-eighth Ayrshire-Sahiwal. Janet, a three-quarter Ayrshire-Hariana grade, gave about 2,900 lb. of milk in her first lactation, while Abigail, a three-quarter Friesian-Hariana grade gave about 4,900 lb. of milk in her first lactation. Many more instances like the above go to prove conclusively that the Friesian is superior to the Ayrshire in crossing and grading up with the Indian breeds. The Friesian not only transmits its milking qualities to its offspring but its characters blend rather than conflict with the characters of certain Indian breeds, so that the progeny do not lack constitution as in the case of the Ayrshire grades.

Camella, a fifteen-sixteenth European cow, of which ten-sixteenth is Friesian and five-sixteenth Ayrshire, leaving only one-sixteenth country blood, gave a 42 lb. daily average during her first lactation at three years of age. She is a fourth generation cow, and in spite of the fact that the Ayrshire was used as the foundation bull and was used again in the second generation, the Friesian blood was strong enough to produce a cow with a strong constitution and a capacity for milk-production. It so happens that the Ayrshire-country three-quarter and seven-eighth grades fall off badly in constitution; and milk production always falls off accordingly. Although according to Galton's law there is only twice as much Friesian blood as there is Ayrshire in the cow Camella, yet it is quite possible that there may be more Friesian blood represented in her, knowing what we do to-day about the makeup of the germ-plasm. In the Lucknow herd seven-eighth Ayrshire-country grades having poor constitutions were crossed with Friesian bulls and the progeny were quite often good, which seems to bear out the point that the Friesian blood in the cow Camella was responsible for her good record. It was Colonel Matson's opinion last November that the Ayrshire was a complete failure as far as using it for grading purposes in the tropics was concerned.

A very interesting experiment of crossing half-bred cows to country bulls showed that the progeny were poor milkers but when country cows were crossed with half-bred Friesian bulls the progeny turned out to be good milkers. This seems to indicate that the sires in both cases were more repotent than the dams, in spite of the fact that in the second case the sire was a half-bred Friesian. When one-quarter European cows (Friesian or Ayrshire) were crossed with country bulls the results were poor, giving a one-eighth cross averaging 6 lb. daily. When the same cows were crossed with a one-quarter Friesian bull the results were good; when crossed with pure Friesian bulls it gave five-eighth crosses averaging 28 lb. daily. The one-quarter Friesian bull had to have a half-bred Friesian bull as a sire. He could not be the descendant of a country sire and a half-bred Friesian dam in order to make any improvement. This all goes to prove that if one knows the breeding of his Friesian bulls, even if they are not pure-bred, he can get fairly good results. Of course it is always safer to use the pure-bred animal. If, however, the Holstein-Friesian proves to be worth while for grading purposes, it would be better for a beginner to start with a grade-bull and then to follow up with a pure-bred Friesian bull rather than delay until he can afford to buy a pure-bred Friesian bull.

The best indigenous herd in India, which has been developed through careful selection for many years, has obtained an average of about 8,000 lb. of milk per year. The foundation cows for this herd were obtained from great distances and were most carefully picked. Are we satisfied with an 8,000 or 10,000 lb. average? Yes, at present, we are, but in the future we will not be. We must strive for higher levels, and I am doubtful if any indigenous breed even after many years of pure-line breeding will pass the 8,000 to 10,000 lb. level.

It may be that this first method of grading with pure-bred Holstein-Friesian bulls as well as with other European bulls that have not been tried may prove unsatisfactory. In that case as far as using this method as a general policy to be recommended for all would be unwise. However, we must wait and see how the experiments now being carried on turn out before any general policy for cattle breeders can be determined. (*The Journal of the Central Bureau for Animal Husbandry and Dairying in India*, Vol. I, Part 3.)

KUNAI.

Kunai (*Imperata arundinacea*) is by far the most serious weed in coconut plantations throughout the eastern tropics and if allowed to exist uncontrolled, will not only be responsible for fewer and smaller coconuts, but will shorten the lives of trees as well. It has been proved conclusively that the growth and bearing of trees have been detrimentally affected by the growth of grass which so mats the soil together that air and water do not penetrate to the coconut roots freely. But in addition to affecting trees in this way kunai has a toxic or poisonous action on coconuts and other cultivated plants, while its presence in a plantation causes the trees to have shorter leaves and smaller crowns.

The quickest and most satisfactory way of dealing with kunai is to plough the land, after first cutting the grass, gathering and burning the uprooted roots, and then sowing seed of Mauritius bean (*Stizolobium aterrimum*). This is a very rampant grower, so that care must be taken that it is not allowed to climb over the trees on a young plantation. During the period of its most vigorous growth the Mauritius bean will be an effective check to the kunai, but after about twelve months it will become straggly and shed many of its leaves. Before it reaches this stage, however, the vines should be turned under with plough or hoes, and any of the kunai rhizomes (the thick cord-like roots) that are still alive should be gathered and destroyed. The land will then be ready for planting up with a more lasting if less rampant cover than Mauritius bean, such as *Centrosema pubescens*, *Vigna hosei*, *Indigofera endecaphylla*, or *Calopogonium mucunoides*. There are some indigenous leguminous plants whose growth should be encouraged on plantations, such as *Desmodium polycarpum*, a low shrubby bush common to many situations in New Guinea from seashore to land of considerable elevations, and often noticeable in abandoned native gardens and *Canavalia rosea* which forms a thick cover on sandy soil right down to high tide level.

Another method of dealing with kunai that may be applied where the planter is without tractor or draught animals is to first cut the grass then dig up pockets every four feet in which seed of *Mimosa invisa* (the giant Mimosa) should be sown.—(*New Guinea Department of Agriculture, Leaflet* No. 63.)

ENTOMOLOGICAL NOTES.

1—Kenya Coffee Mealybug.

The Common Coffee Mealybug (*Pseudococcus lilacinus*, Ckll.) in Kenya Colony. T. W. Kirkpatrick. (*Bull. Dept. Agric.*) Kenya, No. 18, 110 pp., 15 figs. Nairobi, 1927.

Several species of mealybug occur on coffee in Kenya Colony, of these *Pseudococcus lilacinus*, Ckll., is by far the most important. Its food-plants include 31 species, of which 9 are cultivated. The adult deposits from 50 to 200 eggs, probably more, at the time when the coffee flower-buds are available for food, and in 2 or 3 days the young mealybugs crawl for a short distance, generally in an upward direction, and begin to feed. Weather conditions seem to have little effect on the reproduction of *P. lilacinus* but, if food conditions are equal, infestation is always more severe in sheltered positions, probably because they are unfavourable to the enemies of the mealybug. The most important agent in dispersal is wind, particularly the dust storms that usually occur in the warmer seasons; men and animals, especially natives wearing blankets and oxen used in cultivation, also carry the insects frequently, and young coffee plants from infested nurseries are a common source of infestation.

Over 40 species of predators and parasites of *P. lilacinus* are known, but their activities are limited by ants, by far the most important being *Pheidole punctulata*, Mayr. Where mealybugs are well established, there may be three or four ants' nests to each tree, these always being in the soil or under stones, &c., absence of light being essential to them and humidity of the soil an advantage. The food consists chiefly of honeydew from various species of Coccids and from the coffee aphis, *Toxoptera aurantii*, Boy., the preferred source being *P. lilacinus*. The mealybugs multiply three times as rapidly when the ants are in attendance on them, and moreover these destroy practically all of the beneficial insects that are predacious on them. There are no effective natural enemies of the ant, but the warrior ants, *Dorylus* spp., eradicate any that they happen to meet in their path. Torrential rains destroy thousands of them. Five other species of ants, including *Acantholepes capensis*, Mayr, have been found in attendance on *P. lilacinus*.

The most serious damage done to the coffee plant by *P. lilacinus* is the direct loss of crop caused, and since it is the flower-buds and young fruit that are chiefly attacked, it follows that the more healthy a tree is and the better it is able to produce a large crop, the more likely it is to become severely infested. Many of the infested flowers open and the young fruit sets, but before having grown appreciably it dries up, the dried fruit remaining on the tree for a considerable time. Half-grown or larger fruits although less frequently attacked, are sometimes destroyed by a large cluster of mealybugs on the pedicel, but those almost or quite mature

do not appear to be injured. In cases of severe attack all the leaves may be shed. The fruit-fly *Ceratitis capitata*, Weid., is frequently found where there is mealybug infestation, being probably attracted by the honeydew. It is estimated that during the first six months of 1927 the financial loss due to *P. lilacinus* was at least £100,000. Slight damage is sometimes also done to certain fruit trees, especially guavas and custard apples (*Anona reticulata*), and crops recorded as badly attacked include pigeon peas (*Cajanus indicus*), yams (*Dioscorea*) and sweet potatoes.

Recommendations for reducing infestation are to plant only clean nursery stock and to permit as free a circulation of air as possible in the plantation and round the plants. The movement of men and animals from an infested area to a clean one should be avoided so far as possible. No fumigant is known that will kill the mealybug without severely injuring the tree. By spraying, it is impossible to reach all mealybugs on a large tree, and most of the predators are killed or repelled; moreover, natives cannot be depended upon to spray successfully. Of the various sprays tried the most successful have been found to be Castor soap and Solar oil. Painting the affected parts of the tree with methylated spirit or paraffin has given satisfactory results.

As the mealy bug could probably be exterminated by natural enemies if it were not for the presence of ants, every effort has been made to drive the latter from the trees. Although the nests are in the ground, ploughing or harrowing has very little effect, as the ants carry the immature stages into safety and construct a fresh nest. Lime seems to have a slightly repellent action against nest-building; none of the usual manures used on coffee plantations apparently has any effect, but the fact that the ants are attracted to cattle and goat manures can be utilised in concentrating their nests. Poisons were in no case effective, though several of the bait tests are described. Over one hundred methods of preventing ants from climbing coffee trees have been tried. A mixture of four parts of crushed limestone to one part of napthalene is an effective repellent, provided that the weather is absolutely dry and that the mixture is finely powdered; it is probably the best repellent for use on multiple stem trees, where the placing of bands is a laborious and expensive proceeding. Another most effective repellent is a high boiling-point tar oil obtained by distilling creosote or anthracene oil at a temperature of 300°C. (at an altitude of 6,000 ft.), the residue being used. For applying this repellent on large trees (more than two and a half inches in diameter), bands of butter muslin, two and a half to three inches wide, should be soaked in the oil and squeezed until they do not drip. A band of cotton wool should be placed round the trunk immediately below the lowest lateral branch, and over this a band of grease-proof paper four or five inches wide. Over this is applied the oily band. This should repel the ants for three or four months without renewal. Plenty of cotton wool should be used on young trees in order to avoid constriction of the trunk. A safer method for young trees is to soak paper cones in the oil and attach them to the tree with cotton wool under the top rim. Under favourable conditions, a tree so banded may be cleared of the mealybug by natural enemies within three or four weeks.

The nests of *Pheidole* can be most successfully destroyed in October and March, just after the rains, when they are near the surface. Hot water is efficient on small areas; on larger ones the nests should be exposed and a painter's blow-lamp passed over them. Calcium cyanide is effective if a sufficient quantity is used, but is very expensive. Destruction is far more effective if the nests can be concentrated first; they are seldom constructed under the heavy shade of a large tree, so that in a plantation of large trees the nesting places are comparatively restricted, and the nests can be still further concentrated by heaping dead leaves and prunings covered with an inch or two of soil in the open spaces; when the rains start the majority of the nests are moved to these heaps. The ants, however, multiply so rapidly that it is very little use destroying only a proportion of the nests.

In dealing with a widespread infestation where *P. punctulata* is present in numbers, banding should be practised and prunings should not be burnt, but those from trees at the edge of an infested plantation should be carried a few rows outside.—(*Review of Applied Entomology*, Vol. XVI, Series A. Part 6.)

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2—Braconid Parasites.

The introduction of Braconid Parasites of *Diatraea Saccharalis*, Fabr., into certain of the West Indian Islands, by Harold E. Box (*Bulletin of Entomological Research*, Vol. XVIII, Part 4, pp. 365-370).

While enaged as entomologist to the Central Aguirre Sugar Company of Porto Rico the author recommended the importation into that Island of certain larvae parasites of *Diatraea Saccharalis* (the small moth borer of sugar-cane). Based on his previous experience in handling the Tachinid parasite *Lixophaga diatraeae*, which by the way does not effect a sufficiently high percentage of control of the small moth borer, the writer was successful in introducing the Braconid parasite, *Ipobracon grenadensis*, from British Guiana to Porto Rico. After giving a long account of his peregrinations in South America and in the West Indies, and naming the various Agricultural and other officers he met, the author describes his methods and the apparatus used. The type of cage which was found successful is a modification of the Cleare breeding cage (described in the *Bulletin of Entomological Research*, Vol. X, page 43) a full description of which is given. Valuable notes on the feeding and handling of the parasites are given as well as the precautions to be observed after they have been liberated. It is a paper that should be consulted by all interested in parasite introduction work.

F. W. U.

MYCOLOGICAL NOTES.

Macrophomina Phaseoli.

Several references to the fungus *Macrophomina Phaseoli* (Ashby), = (*Rhizoctonia bataticola* (Taub.) Butler), have been made in recent numbers of this journal. These have referred to the occurrence of the fungus on various host plants in different parts of the world including Ceylon, Uganda, India, Egypt, British West Indies and the United States. In the last number of the *Transactions of the British Mycological Society* (Vol. XIII, Parts I and II, pp. 40-68)—Dr. W. Small, has published under the title "On *Rhizoctonia bataticola* (Taub.). Butler as a cause of root disease in the Tropics" a lengthy account of the fungus describing his experiences with it in Uganda and Ceylon. The following extracts from the above paper indicate Dr. Small's most recent views in regard to the fungus with particular reference to the physiology of its parasitism :—

1.—*Rhizoctonia bataticola in Uganda in Ceylon: a comparison.*

"Certain points of comparison between *R. bataticola* in Uganda and Ceylon have been mentioned, but attention may be drawn to the similarity of the hosts and even their identity. The parallel columns give the respective lists.

Uganda.	Ceylon.
Grevillea robusta	*Grevillea robusta*
Camillea theifera	*Camillea theifera*
Theombroma Cacao	*Theobroma Cacao*
Phaseolus vulgaris	*Phaseolus vulgaris*
Albizzia moluccana	*Albizzia moluccana*
A. stipulata	*Accacia decurrens*
Erythrina umbrosa	*A. elata*
E. veluntina	*Erythrina* spp.
E. indica	*Tephrosia candida*
Bixa orellana	*Clitoria cajanifolia*
Casuarina equisetifolia	*Anona muricata*
Sesbania sp.	*A. squamosa*
Codiaeum sp.	*Hevea brasiliensis*
Eucalyptus globulus	*Citrus medica var. acida*
Coffea arabica	*C. aurantium*
C. robusta	*Coffea robusta*
Cupressus macrocarpa	*Cupressus macrocarpa*
C. Benthami	*Rosa* (hort.)
Callistephus sp.	*Hibiscus rosa-sinensis*
Gossypium sp.	*Aralia filicifolia* (hort.)
Sesamum indicum	*Juniperus* sp.
Vicia sp.	*Ochroma lagopus*
Dolichos biflorus	*Tristania conferta*
Pisum arvense	*Musa paradisiaca*
Vetch (from Palestine)	*Lycopersicum esculentum*
Lupin bean	*Capsicum annuum*
	Amherstia nobilis

The manifestations of *Rhizoctonia* disease are similar in Uganda and Ceylon, and in both the hosts are introduced on cultivated plants. The fungus is widely distributed in both countries. Data to show whether it is confined to certain types of soils have not been acquired, and elevation does not seem to have any influence upon its distribution. The planting of certain species implies exposure to the attacks of the fungus and often subsequent disease and death. It shows no restriction of attack and no specialisation, unless in its preference, as far as is known, for dicotyledons. Nevertheless, it has been associated with the plantain and with cypress and juniper, and it is suspected of causing coconut root disease.

A point of contrast between Uganda and Ceylon has been discussed, namely, that *Rhizoctonia* disease in Uganda is less complicated than in Ceylon. This fact would seem to point to a clearer charge of parasitism against *R. bataticola* in Uganda than in Ceylon, but in this Colony the fungus appears to be responsible for much disease and much loss.

It has been mentioned that the parasitism of *R. bataticola* on woody plants in Uganda seemed to depend more upon the resistance of the host than upon environmental conditions, and it is apparent that a similar condition holds in part in Ceylon. As in Uganda, many of the woody hosts succumb after years of apparently normal growth. The plant may be able to hold the attacking fungus at bay for a time or it may be able to retard its progress after its entry; in other words, the progress of the fungus may be slow, as it seemed to be in several Grevillea trees under observation in Uganda. If so, a promising line of investigation is opened up. In tea in Ceylon, for example, the periodic pruning, not to mention plucking, to which the plant is subjected may have adverse effects on the health of the feeding rootlets and may provide in that way an easy point and means of entry for *R. bataticola*. The fungus may not be able thoroughly to establish itself at the first attempt, but subsequent inter-references with the normal processes of the plant may aid its attack and advance in the tissues and lead to its final establishment as a root parasite. It is a remarkable fact that many of the woody hosts of *R. bataticola* in Ceylon are pruned or hacked at intervals, and it is conceivable that the drastic treatment they receive has an influence on the incidence of *Rhizoctonia* disease, *i.e.*, the responsibility for disease may be sometimes laid upon the environment. However, there is no ready means of ridding the soil of a fungus so widely distributed as *R. bataticola*, and a physiological study of the conditions under which the host plants become open to attack may lead to other and indirect methods of combating its ravages. There is really required a study of the physiology of the root systems of tea and other plants with special reference to the influence upon them of conditions of soil moisture, aeration and acidity, to the effects on their roots of the above-ground treatment of the plants, for example, the pruning of tea and hacking of dadaps, and to changes in the reaction or constitution of their cell-sap during periods of growth or recovery after shock, all or any of which studies may throw light upon the reasons for the susceptibility, resistance or immunity of the individual plant or species to root disease in general and *Rhizoctonia* disease

in particular. At the same time, attention to the chemical and physical condition of soils in which the *Rhizoctonia* is prevalent might yield valuable data."

2.—*Conclusions.*

"The writer has been struck, not to say astonished, not only by discovery of *R. bataticola* on numerous plants in a region to which a considerable amount of mycological work has been devoted but also by the conclusions to which his investigations have led, and he is tempted perhaps to make for *Rhizoctonia* larger claims than are justified in the meantime. There is something to be said, however, for the plea voiced at the beginning of this paper, that a search should be made for woody hosts of *Rhizoctonia* in other parts than Ceylon and Uganda, for, frequently, the above-ground condition of Ceylon plants attacked by *Rhizoctonia* corresponds closely with that described from other regions and attributed to other causes. Possible cases in point are the withertip of Citrus in the West Indies, Egypt and India, dieback and death of cacao in various parts, and root diseases and diplodia dieback of Para rubber in the East. The true significance of *R. bataticola* in tropical agriculture will be shown best by the results of investigations conducted in as many regions as possible."

In Vol. V, Nos. 4 and 5 of this Journal, under "West Indies Root Disease" the writer criticised the views which Small had expressed in previous publications (*Trop. Agriculturist*, Vol. LXVII, No. 6, Vol. LXVIII, No. 2, and Vol. LXVIII, No. 4). There is a great difference between the views expressed by Small in his articles in *Tropical Agriculturist* and those given in his more recent paper. With Small's opinions as expressed in the above extracts the writer is in entire agreement.

H. R. B-J.

ST. VINCENT ARROWROOT.

We are indebted to Sir Algernon Aspinall for making enquiries which have resulted in the correction of some of the arrowroot statistics given in the July issue of this Journal. These are as follows (the correct amounts are given in brackets after the figures that were given in the article).

Year.	*Exports of Arrowroot in lb.*	*Value.* £
1908	..4,886,379 (5,611,379)	
1912	—	40,854 (48,854)
1922	..3,627,401 (2,692,130)	

The correct value of the exports for 1925 is £53,174. Readers are referred to recent issues of the *West India Committee Circular* for notes on the progress of the investigation into the marketing of arrowroot.

G. W.

CROP PRODUCTS MANUFACTURE.

Summary of Progress in the Manufacture of Rubber and of Fats and Oils during 1927.

The subject matter for this summary is largely obtained from a series of articles in *The Industrial Chemist*, Vol. IV, No. 36, 1928. The first is by Mr. S. A. Brazier, M.Sc., F.I.C., on Rubber, the second by Mr. Rex Furness, M.Sc., on Fats.

RUBBER.

The motor car industry still remains the largest consumer of rubber. During 1927, it consumed eighty per cent. of the American raw rubber supply. Any increase in motor car production is followed by an increased demand for rubber. The rubber manufacturer is therefore chiefly concerned in the production of efficient material for tyres and tubes. Thus, the introduction of mixed selenium and sulphur compounds as vulcanizers has been used to obtain tyre treads with high rigidity and resistance to abrasion.

The increase in the use of reclaimed rubber is due to two main factors. Firstly, the reclaimed product has been obtained in a uniform condition by careful sorting and grading of the waste material and secondly, the methods of compounding the reclaimed material with the fresh rubber to give a high grade product have been greatly improved. Reclaimed rubber was used during 1926 to the extent of 10 per cent. of the world's total supply of raw rubber. The use of reclaimed rubber is thus becoming a prominent factor in the rubber market.

The 'Anode Process' for the separation of rubber from the crude latex electrolytically has been brought nearer a commercial proposition. Difficulties in the choice of a suitable electrode have been solved by the use of zinc or zinc coated metal. By careful adjustment of conditions, a uniform deposit, independent of the concentration of impurities in the bath is obtained, with a high state of current efficiency. Raw rubber may be separated with the expenditure of only a third of the energy required for the old milling process. Mixed suspensions of reclaimed rubber and raw latex have been successfully deposited. Microscopic and X-ray examination has confirmed the view put forward by C. O. Weber that rubber latex has a two phase structure.

Further avenues for the use of rubber have been opened by the discovery by H. L. Fisher and his co-workers of a new process for the manufacture of thermo-plastic materials. Sheet rubber is heated for several hours with approximately 10 per cent. of its weight of either an organic sulphonyl chloride or an organic sulphonic acid. Thermo-plastic substances resembling gutta-percha and balata which have wide commercial application are obtained. Shellac-like substances have also been obtained by the action of organic sulphonic acids on rubber. The fundamental molecule of all these products appears to be the hydrocarbon of empirical formula C_5H_8.

The factory control of the manufacturing process has been advanced by improvements in the methods for the physical testing and the chemical analysis of rubber.

OILS, FATS AND SOAP.

The year's report on the oils, fats and soap industry is very favourable. Both consumption and production have increased. The only serious aspect of the industry is the decline of the use of glycerine. At one time this valuable by-product was the main support of the soap industry. The production of synthetic ethylene glycol, a substance of similar uses and properties to those of glycerine, in large quantities, has introduced strong competition in the glycerine market. Moreover, glycerine itself has been obtained from molasses by a carefully controlled fermentation process. Difficulties hindering the economic separation of pure glycerine from other fermentation products have been overcome by a distillation process and it is now possible to obtain one ton of glycerine and two tons of alcohol from ten tons of molasses. The combined production enables the glycerine to be sold at competitive prices, and a further rival to soap lye glycerine is thus introduced. At the same time the value of molasses as a by-product of the sugar industry is steadily increasing. The only solution is for the soap manufacturer to find new uses for his by-product.

The margarine industry is being largely influenced by the improvement of hydrogenation control. New methods of preparing the catalyst have resulted in the productions of fats of standard melting point and iodine value. Oils from almost any source, once they have been decolorised, can now be transformed into edible fats.

With improvement in the manufacturing value of raw material, attention has been turned to the food value of margarine. The old fashioned product had practically no food value whatsoever. Ingredients rich in fundamental vitamins are now incorporated in margarine to raise the nutritional value almost to that of butter.

The refining of the raw oils at the place of manufacture rather than at the place of production is advocated.

General research has progressed rapidly. Among the chief advances may be mentioned a proof and study of the detergent value of silicate of soda, and the study of effect of ultra violet irradiation on the cholesterol and ergosterol fractions of fats.

H. H. C.

CONTRIBUTIONS.

THE EDITOR is prepared to consider signed articles for publication in *Tropical Agriculture.* Such articles should normally vary between 1,000 to 6,000 words and may be illustrated if desired. Rates can be obtained on application to the Editor.

REVIEWS.

MONOGRAPHS ON BIOCHEMISTRY. LECITHIN AND ALLIED SUBSTANCES. THE LIPINS. By H. Maclean and I. S. Maclean. 2nd ed. Longmans, Green & Co., Ltd.

This well known series of monographs is further advanced by the publication of this edition. In the new edition, the history of the Protagon controversy is wisely curtailed. The extensive work of Levene and his colleagues in determining the structure of lecithin and kephalin is emphasised. The authors do not conform to the recommendations of the Commission for the Reform of the Nomenclature of Biological Chemistry and continue to use their own term 'lipin' in conjunction with prefixes, rather than the suggested general one of 'lipide.' The nomenclature of biochemistry is so complex that uniformity should be the first aim of authors, even though the generally adopted scheme be not ideal. Apart from this, the monograph is an exceedingly valuable contribution to biochemical works.

H. H. C.

* * *

SILVICULTURAL SYSTEMS. By R. S. Troup, C.I.E., D.SC. (Oxon), F.R.S. Oxford Clarendon Press.

This book, which is a comprehensive work on modern European silvicultural systems, is one which no Forest Officer whether embryo or fully fledged can afford to be without.

In his introduction the author defines what is meant by a silvicultural system and draws up a classification of the main systems. A clear description of each system in its order in the classification follows, usually accompanied by an example of the system—or a modification of it—in actual practise and by notes on its advantages and disadvantages and its application.

The book is plentifully illustrated with diagrams and with photographs of forests treated under the various systems taken by the author in different countries.

As is stated in the introduction "a study of silvicultural systems presupposes a knowledge of the principles of silviculture, while the application of these systems in practice is closely connected with the requirements of forest management," and reference is made to the future appearance of other manuals. The value of the present volume will be still further enhanced when it can be read in conjunction with a manual on Forest Management by the same author.

The better the text book, the greater the temptation to the student to regard it as his sole source of information; and, in the present case, the student will be well advised to take the author's warning to heart and regard this excellent work "not as a means of acquiring a complete knowledge of silvicultural systems but as a guide towards the practical study of systems in the forest."

R. L. B.

LARGE AND SMALL HOLDINGS, Herman Levy, PH. D. Cambridge University Press. pp. viii+249. Price 16s.

THE ECONOMICS OF SMALL HOLDINGS, Edgar Thomas. Cambridge University Press. pp. xii+132. Price 4s. 6d.

Dr. Levy's conclusions are based upon general observations which, while they enable him to cover a wide field, may not find confirmation in closer statistical analysis. A serious defect lies in the fact that the author fails to consider whether, where he is of the opinion they exist, the apparent advantages of the small-holder are not due to his acceptance of a lower standard of living. Nevertheless the book is a stimulating one particularly in its provocative paragraphs.

Mr. Thomas, on the other hand, covers a more restricted area (Carmarthenshire) but attempts to evaluate the labour of the small-holder and his family. He rightly contents himself with pointing out the tendencies suggested by his statistical data and does not fall into the error of considering them as proof positive. It forms a valuable contribution to that mass of information necessary for a correct appraisal of the economic aspects of the problem.

C. Y. S.

* * *

LAND TENURE AND AGRICULTURAL PRODUCTION IN THE TROPICS, By H. Martin Leake, SC.D. (W. Heffer & Sons, Cambridge. Price 7s. 6d. pp. ix + 139.)

The late Principal of the Imperial College has written a small, but most valuable, book on a subject of great importance to the Empire. The writer's great knowledge of agricultural conditions, and especially of administration, in India is naturally reflected in the predominance accorded to that country. This, however, is not inappropriate or, indeed, inopportune, for the recent appearance of the voluminous *Report* of the Royal Commission will inevitably turn the thoughts of many persons at home to the social and economic problems inextricably associated with Indian Agriculture. The perusal of Dr. Martin Leake's book will afford a first-rate introduction to the subject for those who cannot hope to become familiar with the contents of such large works as Baden-Powell's *Land Systems of India* or the corresponding treatises on revenue. The activities in fresh fields, recently undertaken by the Colonial Office, the Empire Marketing Board and the Cotton Growing Corporation, are also directing the attention of young Englishmen (both in their official and private capacities) throughout the Tropics to fresh phases of problems long familiar to Indian Directors of Agriculture. It is, indeed, true to say that, as at home, so Overseas, the questions that most urgently call for answer are those associated with the economic and financial aspects of the industry.

The book comprises six chapters and three Appendices. The former include brief surveys of the historic development of land tenure in India, followed by a wider review of the many aspects of present-day tenancy, with special reference to taxation and the position occupied by the State in relation to Agriculture in tropical countries. In Chapter VI the author criticises the lack of technical education available in India, a subject to which he returns at fuller length in the third Appendix. Reprinted from *The Agricultural Journal of India,* the second Appendix contains most interesting material demonstrating the correlation between rainfall and wheat area, which in turn leads up to a discussion of the possible future expansion in mechanical aids to irrigation.

As would be anticipated, a book by the author of *Foundations of Indian Agriculture* is pleasingly written ; it is, moreover, well printed and adequately indexed.

J. A. V.

BOOKS RECEIVED.

WE have to acknowledge the receipt of the following books :—

BOTANY.

A Manual of Plant Breeding for the Tropics. M. B. Mendiola, pp. 366. *Philippine College of Agriculture,* 7s. 6d.

Flora of West Tropical Africa, Vol. I Part 2. J. Hutchinson and J. M. Dalziel, pp. 524. *Crown Agents for the Colonies,* 8s. 6d.

CHEMISTRY.

Colloid Symposium Monograph. H. Boyer Weiser, pp. 394. *The Chemical Catalog Co.,* $6.50.

ECONOMICS.

Hundred Acre Farm. G. T. Garratt, pp. 142. *Longmans, Green & Co., Ltd.,* 5s.

GENERAL.

Ferguson's Ceylon Directory, 1928. *The Ceylon Observer Press.*

The Importance of an Adequate Intelligence Service for the Rubber Industry. S. S. Pickles, pp. 28, Reprinted from *The Rubber Age,* January, 1926.

Library Catalogue, 30th June, 1927, pp. 210. *The Research Association of British Rubber and Tyre Manufacturers.*

Summary of Current Literature. Vol. VI, No. 3 March, 1928. *The Research Association of British Rubber and Tyre Manufacturers.*

SUGAR TECHNOLOGY.

A Handbook for Cane Sugar Manufacturers and their Chemists. G. L. Spencer, 6th Edition, pp. 562, 93 figs. *Chapman and Hall., Ltd.,* 20s.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Control of Chlorosis.

The chlorosis or yellowing of plants is attributed to a deficiency of available iron in the soil, followed by a deficiency in the plant itself. Its occurrence is usually associated with soils containing a very high percentage of lime. In Hawaii, however, pineapples show chlorosis even when growing on soils containing normal or low amounts of lime. It has been found that the availability of iron in the soil depends largely on two factors, namely, the relative acidity or alkalinity of the soil, and the relative oxidizing or reducing agent in the soil. In normal soils ferric iron appears to be unavailable to plants subject to chlorosis. The requisite iron is therefore supplied by ferrous salts.

Two methods of increasing the supply of available iron are used. The first consists in the direct addition of ferrous salts to the soil. In Hawaii, the manganese dioxide present rapidly oxidizes the iron to the ferric state. Large single applications of ferrous salts therefore produce little effect, but small, frequent applications ensure a regular supply of ferrous iron for the plant.

In the second method of control, the leaves of the plant are sprayed with a 4 to 6 per cent. solution of iron sulphate. A modification of this method is suggested. Marcasite, a crystalline sulphide of iron, mixed with one-third of its weight of infusorial earth to facilitate distribution is dusted on to the affected leaves. The exposed surfaces of the crystals become oxidized by the air to form soluble iron salts. These salts are washed away by rain and dew to be absorbed by the plant. Meanwhile fresh surfaces of the crystals are exposed. A continuous supply of soluble iron salt is thus given to the leaf. An application of 8 pounds of marcasite per acre every two months is found suitable for controlling chlorosis in pineapples.

Marcasite was found particularly useful in controlling chlorosis in sugar-cane. Tests showed a striking recovery in treated plants.—(M. O. Johnson, *I. E. C.*, 20, 724.)

* * *

Edible Rice Cellulose.

It is essential that human diet has bulk as well as food value. A diet consisting entirely of proteins and starches leads to constipation, but when a bulk or 'roughage' of cellulose is present, digestion proceeds on its normal course. A breakfast food manufactured from milled rice had a very low cellulose content, and thus was not an ideal food. The deficiency has been overcome by the introduction of a pure edible cellulose made from the hull of the rice. It is prepared by cooking the hull with strong caustic soda solution followed by a hydration treatment to reduce it to a physical form suitable for use as an edible material. In the final state it is a light, fine, mealy, material. It is odourless and tasteless, and has a mealy feel in the mouth. Analysis of the finally purified product shows it to be practically pure cellulose.

Tests on its dietary value have been carried out on various subjects. In all cases the cellulose added to the milled rice obviated the ill effects of a diet of pure milled rice. It is suggested that the cellulose content of other foods be augmented by the addition of this edible rice cellulose.—(*Ind. and Eng. Chem.* 20, 310.)

* * *

Chemical Control of Plant Growth.

It is often desirable to have plants which will flower or seeds which will germinate before their normal time. Previously this has been brought about (as in the case of wheat) by selective breeding of early varieties. In the process of breeding the new variety, there is always the possibility of losing valuable properties of the parents. It is found that chemical treatment of a seed or tuber will cause it to germinate prematurely, or a bud to flower prematurely. Experiments have been conducted particularly with potatoes. The potato tuber has a dormant period during which it will not sprout. In places where two crops are grown during one year, the length of the dormant period prevents the second crop from being planted with seed from the first. The dormant period is shortened considerably by soaking the cut tubers in one per cent. sodium thiocyanate solution for one hour, and then planting the pieces without rinsing. A similar effect is obtained by using ethylene chlorhydrin solution or vapour. Treatment with thiourea induces multiple bud development in the potato.

Somewhat similar treatments have been applied to small woody plants such as lilac and Deutzia. By exposing the young plants to ethylene chlorhydrin or ethyl bromide fumes, they were induced to bloom from two weeks to two months prematurely. The more concentrated solutions produced the greater effect, but at the same time the concentrated solutions reduced the number of flowering spikes. The main object at present is to enable florists to produce flowering plants in time for holiday trade. The idea may, however, have wider application. The seed treatment, especially, could readily be used with other field crops. In cases where early fruiting or rapid establishment of a plant is required to avoid, or to enable the plant to withstand, bad weather or the incidence of a pest, the treatment may prove of great value.—(*Ind. and Eng. Chem.* 20, 578.)

COLLEGE ELECTRIC LIGHT AND POWER HOUSE.

Photograph by *Tucker Picture Co.*

INTERIOR OF ELECTRIC LIGHT AND POWER HOUSE.

Photograph by *Tucker Picture Co.*

COLLEGE SWIMMING POOL.

Photograph by Tucker Picture Co.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

The Economic Basis of Cane Transportation.

J. Radersma (Handelingen van het Tiende Congres (1928), Part 5) goes thoroughly into all the economics and engineering phases of transporting cane from the fields to the mills.

The two main objects to be attained by a good system of cane transport are to enable the manager to have the cane cut at just the right degree of ripeness, and to supply the mill with a certain fixed quantity of cane every day; and the whole system must be managed at the lowest cost compatible with efficiency. The greatest single item of cost is that of fuel, and here the author finds the plantation railways comparing unfavourably with public railways of the same gauge using the same kind of locomotive; these latter use 0.08 kg. stone coal or 0.144 kg. wood per ton-kilometer, whereas the best figure found for any Java sugar factory was 0.2 kg. stone coal or 0.36 kg. of wood. Evidently the technique of firing plantation locomotives still allows considerable room for improvement.

The author has calculated the most favourable distance between temporary tracks in the cane fields and obtains it by the following formula: $2 \times \sqrt{\frac{a}{10\ C.e.}}$ kilometers, wherein a is the cost in gulden of taking up and relaying the temporary track, C the cane yields in tons per hectare, and e the cost of dragging the cut cane to the cars in ton-kilometers. In most cases in Java this distance turns out to lie between 47 and 93 meters. By another formula the author calculates that lines of permanent track are most favourably placed if they are not more than one kilometer apart, which would make the greatest length of temporary track 500 meters.

Motor locomotives burning gasolene are unprofitable in Java where the distance is above 2 or 3 km., as is generally the case; in such circumstances steam locomotives are more economical even if they burn coal. The lowest duty of an 80 h.p. locomotive on a Java plantation was found to be 16,000 metric tons per campaign, and the highest 50,000 tons.

There are plantations in Java that have one km. of track to each 15 hectares of cane: In others the ratio is as high as 1 : 30. Maintenance of permanent track costs 140 florins per year km., to which is to be added 150 florins for renewing ties, rails and bridges. The cost of maintaining permanent track figures out at 8 to 16 Dutch cents per metric ton of cane, to which is to be added 1.5 to 2.5 cents for maintaining temporary track; maintenance of an 80 h.p. locomotive adds a further charge of 2 to 6 cents per ton and maintenance of cane cars 3.5 to 7 cents (a Dutch cent is $0.004). The author concludes that under Java conditions one km. of track should serve at least 20 hectares of field; otherwise it will be cheaper to use ox carts.

The author has studied the question as to how the extension of area under cane tributary to the factory affects the cost of transport and finds that addition of new area does not increase the cost of sugar so long as the increased cost of cane transport does not exceed fixed overhead chargeable to the transportation system. For Java factories this limit is 560 Dutch cents ($2.24), where extension of plantings involves no additional factory construction.—(*Facts About Sugar* 23, No. 19, p. 443.)

* * *

Divergence in p H.

H. A. Cook and W. R. McAllep (*Hawaiian Planters Record*, Vol. XXXIII, Nr. 3) provide an explanation of the difference in pH of clarified juice before and after settling. There is a difference between the pH of the clear juice and that of the 'mud' which settles from it and at any given concentration of solution and precipitate an equilibrium is established. This equilibrium is evidently a factor influencing the pH of the mixture. With a change in the relative concentration of solution and precipitate this equilibrium is changed with a resulting change in pH. If the clear juice and the precipitate are re-mixed, the original pH of the turbid juice before settling is restored.

Divergence in pH is of material significance from the standpoint of pH control of factory operation. Tests for clarification control should be made on a portion of the hot-limed juice from which the precipitate has been separated. When the reaction of the hot-limed juice is about 8 pH, the error due to testing the turbid, instead of the clear juice, will usually be small, though even in this range divergence amounting to as much as 0.3 pH has been found in some juices. As the clarification pH decreases, the error due to making these tests on turbid juice increases, and the results become so misleading that they are of little value for control purposes. As divergence varies greatly in different juices it is impracticable to apply a correction, and the only alternative is to make pH tests for clarification control on the clear juice.

From the standpoint of inversion velocity, however, the pH determined in the presence of the precipitate should be considered the significant figure as long as the precipitate remains in suspension. In the case of settlings the pH of the settlings and not the pH of the clear juice separated therefrom should be considered as the pH related to inversion velocity.

We have to acknowledge, with thanks, the receipt of four copies of the Cambridge University Agricultural Society Magazine, for 1924-1928.

COTTON NOTES.

Studies in Indian Fibre Plants.

No. 3 on the Inheritance of Characters in "Hibiscus sabdariffa" L.

A. HOWARD, C.I.E., M.A., F.L.S., AND G. HOWARD, M.A.

Mem. Dept. Ag. Ind. Bot. Ser., Vol. XIII, No. 3, June, 1924.

OWING to lack of sufficient land, this investigation had to be given up. The present memoir is therefore a progress report.

Data are incomplete and for many characters quite inconclusive. Doubt attaches to the interpretation of the figures in some cases where fairly complete data are given, *e.g.*: Table 1:9 F_2 families give 2056 ruber: 610 albus, and the ratio is interpretated as resulting from a difference in a single gene. The deviation from expectation is 56.5, and is 2.5 times its standard error. The hypothesis of a single gene difference clearly fails to account for the facts. Some of the segregating F_3 families (exact parentage unfortunately, not stated) show considerable deviations from the expected 3 : 1 ratio— *e.g.* Fam. 2 Table II and as a group they can hardly be considered homogeneous. The only comment on these discrepancies is "The experimental numbers obtained do not agree very clearly with expectation, but the error is reversed in the two generations." Where a considerable deviation from expectation occurs in F_2, lumping of data from segregating F_3 families is quite unjustifiable unless they are statistically homogeneous and a comparison between such lumped data and F_2 figures is meaningless.

Similar behaviour is shown in inheritance of colour of the faded corolla. Data from F_3 segregating families are lumped. Complete data might have been given without taking up any more space, and some analysis of the cause of the deviation might then have been possible.

It would be worth while making germination counts in any further investigations. These deviations may be due to the operation of genes for seed dormancy linked with the ruber gene and with the gene controlling colour of the faded corolla.

Sufficient has been said to show that where figures are given they are treated uncritically. It is difficult to comment on the treatment of characters for which no figures are given, as the work was admittedly not complete, but since Mendelian theory and modern statistical method have turned genetics into an exact science, it does not seem justifiable to discuss so many genes at such great length without the aid of figures.

J. B. HUTCHINSON.

COLLEGE NEWS.

Lectures for the session 1928-29 will begin on 8th October, 1928.

* * *

Professor F. Hardy accompanied by Mrs. Hardy and child, returned from England by s.s. *Carare* on 26th August.

* * *

Professor Shephard wishes to express his thanks to all who have assisted him as Editor of *Tropical Agriculture*, during the past four years.

* * *

Dr. C. W. Wardlaw, Pathologist to the College Banana Research Station, returned from his tour in Central America *via* Jamaica by the s.s. *Bayano* on 7th September.

* * *

Mr. L. A. Corbin, Accountant and Manager of the Milner Hostel sailed for Barbados by s.s. *Camito* on 10th August and returned by s.s. *Antillian* on 28th August.

* * *

The Principal, Professor and Mrs. H. A. Ballou, Dr. and Mrs. H. R. Briton-Jones and Dr. Lawrence P. McGuire, Banana Research Physiologist, are expected to sail for Trinidad by s.s. *Ariguani* on 10th September, arriving 23rd September.

* * *

The Colonial and Empire Cotton Growing Corporation post graduate students accompanied by three other students, two of whom are taking refresher courses, and one a special course in Chemistry, are due to arrive in Trinidad by s.s. *Carare* on 7th October.

* * *

The following have recently visited the College: Major J. C. Craig, Director of Public Works, British Guiana; Mr. F. Balfour-Browne, Professor of Entomology, Imperial College, London; Dr. Clarence F. Jones, Professor of Economic and Commercial Geography, Clark University, Worcester, Massachusetts; Mr. W. Parry Okeden and Mr. W. Livingston.

* * *

Mr. A. K. Briant, who has been appointed Lecturer in Mycology at the College was educated at Dauntsey School, West Lamington, Wiltshire, and Cambridge University, where he took Part I of the Natural Sciences Tripos, and Part I and II of the Diploma in Agriculture. He came to the College as a Colonial post graduate student in 1927-28, and is due to arrive in Trinidad by s.s. *Ariguani* on 23rd September.

* * *

Amongst the Colonial Appointments announced during the month of July, the following students who were in residence at the College last session have been nominated by the Secretary of State for the Colonies:

Mr. H. R. Hosking, B.Sc., A.R.C.S., Assistant Cotton Botanist, Uganda.

Mr. A. H. Savile, Agricultural Officer, Tanganyika Territory.

Mr. N. V. Rounce, Agricultural Officer, Officer, Tanganyika Territory.

COLONIAL APPOINTMENTS.

The following appointments have been made by the Secretary of State for the Colonies during the month of July, 1928.

Mr. H. A. Hay-Barclay, M.R.C.V.S., Veterinary Officer, Agricultural Department, Kenya.

Mr. E. R. Guest, B.Sc., A.R.C.S., Plant Breeder, Iraq.

Mr. R. W. E. Tucker, M.A., B.Ed., Entomologist, Barbados.

Mr. H. G. Pudney, Produce Inspector, Agricultural Department, Nigeria.

Mr. S. L. Binns, Assistant Commissioner of Lands, Gold Coast.

Mr. G. C. SKINNER.

As we go to Press we learn with deep regret of the death in England on 6th September, of Mr. G. C. Skinner, General Manager of the Ste. Madeleine Sugar Co., Ltd., and a member of the Governing Body of the College. A service in his memory was held at St. Clement's Anglican Church on Monday, 10th September when the College was represented by the Hon. W. G. Freeman, Governor; Professor R. C. Wood, Acting Principal; and Professor C. Y. Shephard. An obituary notice will appear in the next issue of the Journal.

PHOTOGRAPHS.

The photographs found on page ix represent the Students' Reading and Card rooms, both of which are situated on the upper floor of the College Dining Hall already described in Vol. V, No. 4, of the Journal. A portion of the dining room on the ground floor of the same building appears on page x together with a photograph taken from the verandah of one of the thirty-two students' bed sitting rooms in the Milner Hostel. Each room is fully equipped with all necessary furniture, is electrically lighted, and a wash stand with a supply of running water is also provided.

The electric light and power house shown on page xi was built at a cost of £7,120, and is equipped with two Ruston Hornby 45 h.p. 3. V.A. Type Engines, which are directly coupled to two Crompton 25 K.V.A. alternators. Crompton switchboards will also be seen in the back ground of the interior of this building.

The swimming pool on page xii is one of the most popular amenities of the College and is 56 feet long by 44 feet wide, the shallow end for non-swimmers having a depth of 4 feet, which is separated by a rope from the remainder of the pool which has a depth of 7 feet.

Professor C. Y. SHEPHARD, B.Sc. (Econ.)

An Appreciation.

In September, 1924, Professor Shephard relieved Professor Dunlop of the Editorship of the Journal, first published in January of that year. With this issue, however, he severs his long and successful connexion with *Tropical Agriculture*, the success of which has depended on many factors, such as scope, breadth of treatment, up-to-date criticism, and appreciation of current agricultural events, and suitable advertisements as a source of financial support, and lastly an 'ensemble' which makes the Journal suited to the needs of its many and varied readers. To assemble a well balanced publication of this kind is no easy task, and it is clear that it could only have been achieved by one whose exceptional wealth of general knowledge of tropical agriculture brought a generous outlook to bear on the treatment of this subject. The very high standard of the articles published in the earlier numbers gives ample evidence of Professor Shephard's qualities as an Editor, and of the spirit with which he did his work. The rapid growth of *Tropical Agriculture* is evidenced by the fact that it was increased first from a size of 16 pages with no illustrations, to 20 pages, then (February, 1925) to 24 pages, till finally in August, 1926, illustrations were first introduced and have formed a feature ever since. Besides the regular monthly numbers, four supplements were issued in 1925 dealing with the College; the Sugar Factory; Lord Milner's appeal for an endowment fund for the College, and a deputation to Mr. Amery, the Secretary of State for the Colonies; and in 1927 a most successful Sugar Supplement was produced.

Although Professor Shephard was in charge for the last four years, he would be the first to acknowledge the help which he has received from his colleagues on the staff, and particularly from Professor Ballou, who acted for him for some months in 1926, and from Mr. Wright, who was appointed Assistant Editor, in November, 1926, and acted as Editor during Professor Shephard's absence in 1927. With the exception of occasional minutes of the Academic Board recording discussions on some point of policy Professor Shephard laboured alone, the bulk of the Journal being a testimony to his industry and wide reading. Mr. Gianetti, who is the new Editor will find a sound tradition to follow, and is fortunate in having his predecessor in office still at hand to help him. The strong position which the Journal now holds throughout the Empire, may be accepted as a tribute to the exceptional qualities which Professor Shephard brought to his task.

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Throughout August there was little change to notice either in values or as regards the general outlook. Quotations during September were as follows: foreign, c.i.f. per cwt. 11*s.* 7½*d.* (1st Sept.), 11*s.* 6*d.* (3rd Sept.), 11*s.* 4½*d.* (6th Sept.), 11*s.* 3*d.* (8th Sept.); preferential c.i.f. per cwt. 15*s.* 4½*d.* (1st Sept.), 15*s.* 3*d.* (6th Sept.). In spite of the large purchase by United Kingdom refiners of Cuban Sugars to which reference was made in our last issue, there was later quite a good demand for Raw Sugar for early shipment and at the beginning of August, 10,000 tons Cubans were purchased *ex warehouse*, New York, at 11*s.* 4½*d.* c.i.f. United Kingdom. Antagonism in Cuba to the policy of restriction appears to be growing, and it is understood that a large percentage of the planters in the island favour an unrestricted crop next year, and have signed a petition to President Machado to this effect.

* * *

COCOA.—There has been little of interest in the cocoa market since the last report, but around the middle of August there was just a little better feeling as far as Accra was concerned, and it looked as though the bulk of liquidation in New York had ended. This resulted in some enquiries from manufacturers for new crop, particularly for early positions. There have been hardly any enquiries for spot parcels.—(*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*) Cabled quotations for September (to 8th Sept.) are as follows: Trinidad, L.L.T. per cwt. 65*s.* to 72*s.*; Grenada, L.L.T. per cwt. 65*s.* to 66*s.*

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COTTON.—During August (23rd Mid-American 10.60*d.*) the market was nervous and apprehensive, business was small as recent sharp fluctuations caught operators both ways. Weather in the South is said to be the dominating factor, but at times the market acts contrary to this theory. The Garside Cotton Service cable stated "Unless shedding becomes unusually severe, expect yield above average." In Egyptian better business than anticipated was done on the Spot in good fair to fully good fair uppers, but Sakels were quiet. African was quiet and East Indian in moderate demand. Sea Island was in limited demand without change in quotation.

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COFFEE.—In their report of 20th August, 1928, Messrs. Woodhouse, Carey & Browne state that on the resumption of sales after the August holidays a shipment of Blue Mountain Jamaica sold well, up to 230*s.* 6*d.* per cwt., being paid for fine bold sizes. A few lots of East Indian were disposed of at steady prices; medium quality foreign cleaned Colombian was withdrawn from sale failing satisfactory bids. Good colory Costa Rica sold at 170*s.* per cwt. for bold sizes, second size at 144*s.* per cwt. The second day's auctions saw a few parcels of New Crop Kenya Coffee offered, up to 137*s.* per cwt. was paid for London cleaned and 120*s.* 6*d.* to 135*s.* 6*d.* per cwt. for foreign cleaned.

* * *

TEA.—Large sales of Java at 8¼*d.*, of Southern Indian at 11*d.*, and of N.E. Indian at a like price gravely reduced the Java and Indian averages at the end of August. Export demand was mainly for Indian and Java cheaper sorts and fell off for good tea, Chinese and Ceylon.

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RUBBER.—The Report of Messrs. Figgis & Co., for 23rd August states, "The market for Eastern Plantation Rubber has been quiet and prices are about ¼*d.* per lb. lower. Some liquidation of September delivery which sold at 9¼*d.* was the chief cause of the decline." Sales of Standard Spot Ribbed Smoked sheets September delivery were down to 9$\frac{3}{16}$*d.*, Oct.-Dec. down to 9$\frac{5}{16}$*d.*, Jan.-Mar., 1929, to 9$\frac{5}{16}$*d.*, April-June to 9$\frac{7}{16}$*d.*, and monthly deliveries over 1929 at 9½*d.* per lb.

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COPRA.—All sorts of coconut, whole, broken and desiccated are said to be singularly out of favour at the moment. West Indian is quoted at £25 10*s.* per cwt. c.i.f.

TRINIDAD SUGAR, 1928.

THE Trinidad Cane Farming and Sugar Crop Returns, 1928, which are compiled by the Agricultural Society put the total sugar made in the island at 81,551 tons, the largest crop on record, the best one previously being that of 73,561 tons in 1926; while the average for the past 5 years, 1923-27, stands at 57,767 tons. Of the 81,551 tons of sugar, 45,251 tons were made from 449,634 tons of estate cane (9.93 tons cane per ton sugar) and 36,300 tons from 375,162 tons of purchased cane (10.33 tons cane per ton sugar). The amount paid for the purchased cane was $1,116,722, an average of $2.98. A note at the foot of the schedule issued by the Agricultural Society states "amounts shown as paid for canes represent interim payments of $2.88 per ton in the 5 per cent. sliding scale. There is a final instalment still to be paid when price has been ascertained." The total number of farmers was 20,668 (average 1923-27 19,073), 13,224 being East Indians and 7,444 West Indians.